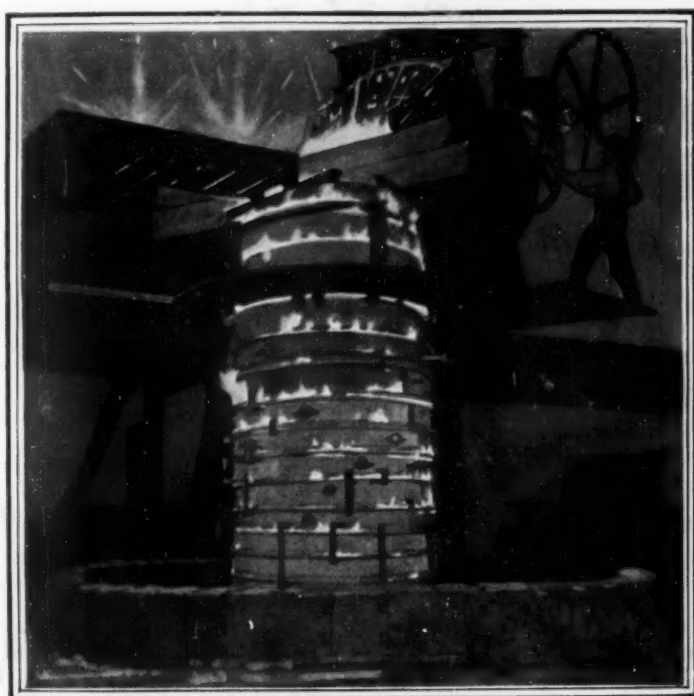


SCIENTIFIC AMERICAN

OCTOBER 1927

Thirty-five Cents a Copy



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BY DAVID STARR JORDAN

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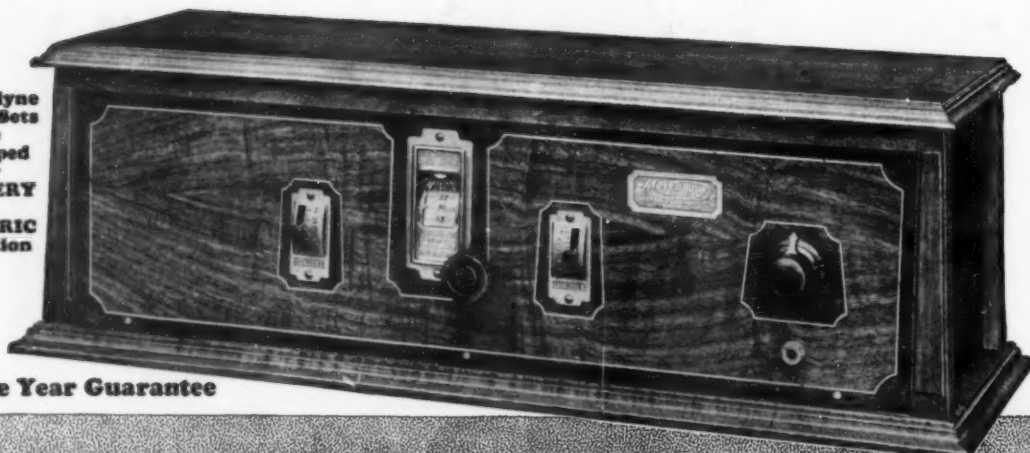
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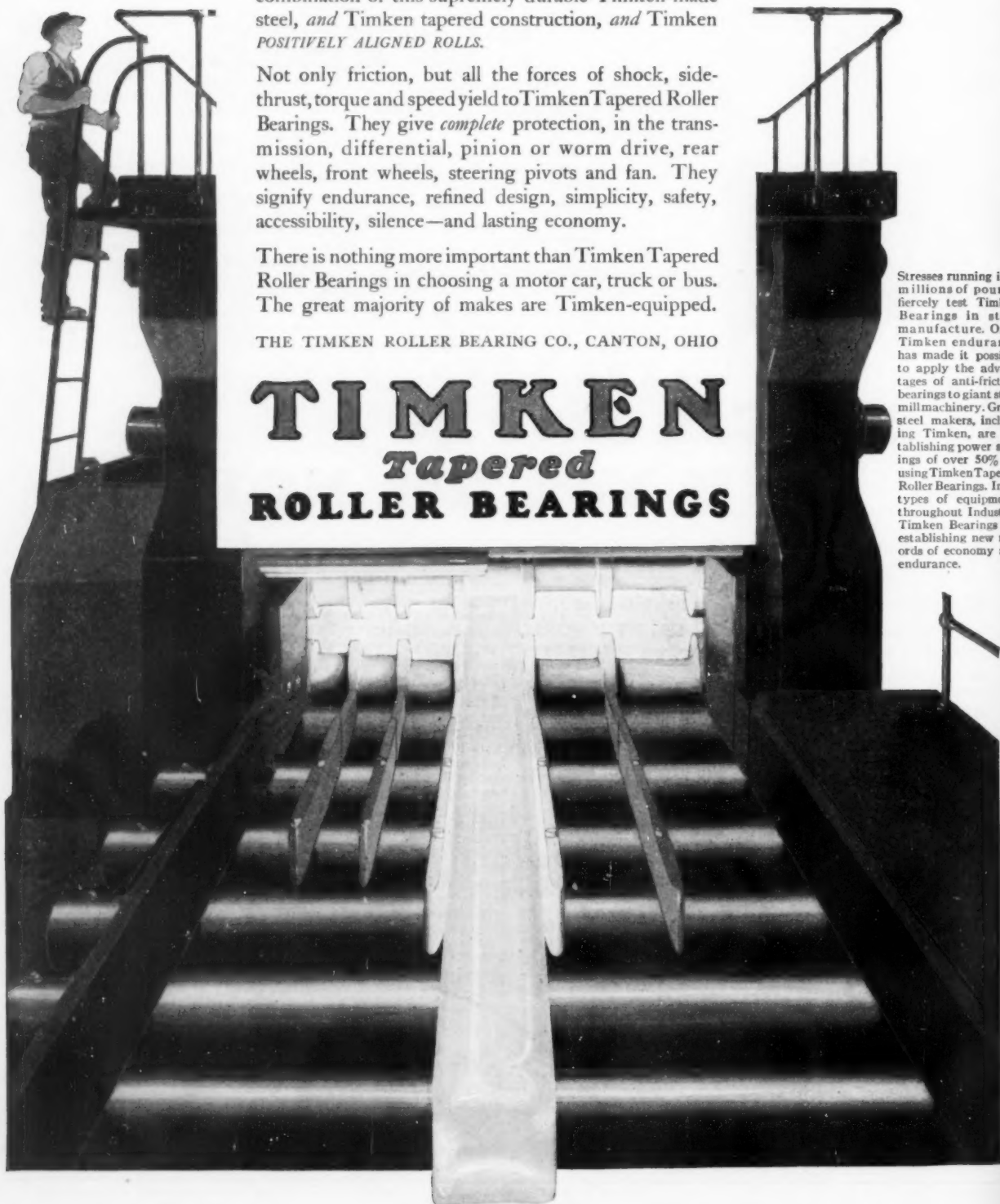
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SCIENTIFIC AMERICAN

October 1927

Edited by ORSON D. MUNN

Eighty-third Year

Amateurs

THE average amateur scientist would like to feel that he could do something for the advancement of science. But is there very much an amateur can do that has not already been done by the professionals?

Well—we know of two jobs an amateur can do and do well. One is to make a small telescope and join the American Association of Variable Star Observers, with easy non-technical duties of great worth, nevertheless, to science; the other is to keep watch of excavations in his own locality to see that valuable fossils and ancient human evidences are not lost to science. Both jobs represent cases where numbers are needed, rather than the more highly trained work of the professional few.

In the former, charts and simple instructions are furnished and certain stars are assigned for regular observation—in fact the observer is almost given a quit-claim deed to these immense bodies. In the latter there is no association or society, but if a few thousand of our readers were to keep an eye on local excavations for cellars and engineering jobs, we believe some things of great value to science would be saved from the hungry jaws of the steam shovel.

Risky

INTERFERENCE between high-frequency radio waves that travel one way around the earth, and those that choose the other path around, is thought by a German named Quack to mutilate the signals recorded at the receiving stations. The Telefunken Company has proved that these waves do run around the earth in different directions, the time lag when transmitting being .096 of a second.

But why a single echo? Why not two? Or three? Or more? When, in fact, do these rampant radio waves stop in their tireless course?

Can it be that after a century or two of radio broadcasting these waves will begin to accumulate and get under foot, so that the poor harassed world will have to have a special squad of "radio white-wings" to gather up all of the used radio waves and burn them?

Nonsense

THE much talked of Hindu savant, Sir Jagadis Bose, has published another book about the souls of plants, and this is a thumbnail review of it. In "Plant Autographs and Their Revelations" (Macmillan, 1927) Sir Jagadis not only attempts to show that plants are endowed with feelings akin to those of man, but that metals are alive and can be killed with poison!

This popular book on botany, which has already been favorably received by uncritical new-thought healers, lovers of the occult, Yogi philosophers, dreamers, poets and pseudo-poets, gullible Sunday supplement editors and pseudo-scientists, will

make a hit with all that quivering category of the emotionally unstable whose feelings joyfully run away with their rational faculties. But not with trained botanists.

The language is indeed charming and the book is interesting. What a trap for the unwary!

Science

ELEPHANTS are intelligent. Everybody likes elephants. They pile teakwood and we have heard it said that they do this without human direction. Elephants also have a long memory and take terrible revenge on aged men who as children fed them peanuts stuffed with cayenne pepper. Now we are asked to believe another, which appeared in a New York daily. Source: The Indian News Service.

It seems that a forest fire was rapidly spreading in India when the leader of a herd of wild elephants "smelled the fire and came to the road in order to satisfy his natural curiosity. The moment he saw the fire spreading to the forest he called his

followers by loud trumpeting and within a few moments a well disciplined band of dusky four-footed firemen were busily employed, with their trunks as hose, turning 40 streams of water on the blazing tree and burning woods." Very soon, the dispatch continues, the fire was put out.

This story came out of India. But so did Sir Jagadis Bose, the Hindu scientist who would have us believe that metals are alive and that plants have souls. Altogether, India must be a wonderful place.

Cover

THE writer recently paid a visit to the plant of the Buffalo Foundry and Machine Company at Buffalo, New York, and was impressed by the preparations made for casting an ingot mold. Later a photograph was secured of the pouring and this has been translated into color by our artist. The ingot mold which is being cast weighed 125 tons. Three or four ladles are required to furnish sufficient molten metal to prevent cold shuts.

CONTENTS

OCTOBER 1927

Troglodytes of the Desert—By Horace D. Ashton	297
Mikimoto and the Culture Pearl—By Prof. David Starr Jordan	300
A Modern Man-Made Cave	303
Our Point of View—Editorial	304
New Radio Aid to Aircraft Pilots	305
Placing Staten Island on the Map—By J. Bernard Walker	306
On the Trail of the Molecule—I—By S. R. Williams, Ph.D.	309
Four Sunless Worlds—By Henry Norris Russell, Ph.D.	312
The Month in Medical Science—By Morris Fishbein, M.D.	314
Cold Light—By Dr. W. W. Coblentz	316
In the Workshop of the Scientists	318
A Radio Pioneer Steps Forward—By Orrin E. Dunlap, Jr.	320
Out of the Silence Comes a Voice	323
Africa—By Martha Miller Bliven	324
Successful Inventors—X—By Milton Wright	328
400,000,000 Horsepower!—By E. H. Lockwood	330
Piano Instruction Aided Electrically	333
The City of the Future—II—By Ernest Flagg	335
Speeding Up the Moffat Tunnel	338
From the Scrapbook of Science—Camera Shots of Scientific Events	340
Outward Bound on the "Ile de France"	342
Household Inventions	343
Inventions New and Interesting	344

DEPARTMENTS

THE SCIENTIFIC AMERICAN Digest	345
Industries from Atoms	350
Learning to Use Our Wings	352
Applied Science for the Amateur	354
Radio Notes	356
The Heavens in October	362
In the Editor's Mail—Where Reader Meets Reader	372
Commercial Property News	379
Patents Recently Issued	379

Los Angeles County "Draws" the Winning Hand

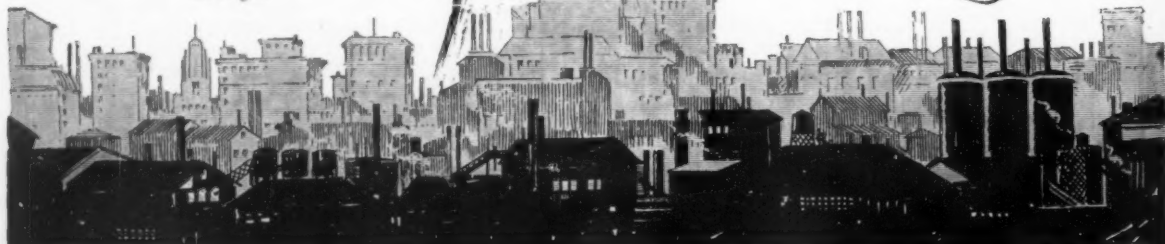
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To "play" for the rich stakes of western markets, these four internationally known manufacturers are investing \$20,000,000.00 in new plants here. By coming to Los Angeles County, the West's economic distribution center, they have strengthened their "hands" in the bid for Western business.

*For manufacturing and distribution facts, address the
Industrial Department, Chamber of Commerce,
Los Angeles*

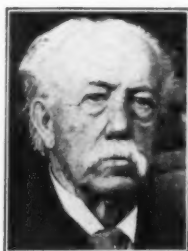


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Among our Contributors



PROF. DAVID STARR JORDAN

Retired president of the well known Leland Stanford Jr. University in California, which he built up from a small beginning to academic fame, Dr. Jordan is a naturalist, most of whose life work has been devoted to the scientific study of fishes. The author of many books, he now devotes his time to writing. Better than many scientists he understands the knack of popular authorship. For example, see article on page 300.



PROF. S. R. WILLIAMS

To many of us, the abstract study of physics is as dry as an Arizona summer. But there are in physics a number of concrete applications to daily life, and simple experiments which sometimes baffle, but always entertain and provide food for thought. Professor Williams of Amherst College has grouped together a number of these experiments in a two part article which begins on page 313. Don't miss it.

Dr. W. W. Coblentz

With electricity, man has turned night into day. But the firefly accomplishes as much without a thought and does it without loss of energy due to generation of heat. Will man ever succeed as well as the firefly? On page 316 Dr. Coblentz outlines this baffling problem.

Horace D. Ashton

Near ancient Carthage, northern Africa, a people often simply known as "the troglodytes of the desert" dwell underground in spacious rooms carved out of dry marl. They lead a peculiar existence which is depicted on page 297, by Mr. Ashton, a fellow of the famous Royal Geographical Society. He has lived among these odd people.

Prof. E. H. Lockwood

We have been in the habit of measuring the power of a motor car by the power of the engine. But does this tell the whole story? No! Professor Lockwood of Yale has worked out a practical technique for finding out how much power a car puts on the road. Explained on page 330.

Martha Miller Bliven

For years Mrs. Bliven was secretary to Carl Akeley, the noted explorer, accompanying him on his first trip to Africa. There Akeley taught her to shoot straight. Later she spent four years in French West Africa. Her account of a trip in the Belgian Congo (page 324) will arouse all the reader's suppressed instincts of wanderlust.

Looking Ahead with the Editor

GHASTLY

Head hunting tribes in a wild district of British Burma until recently sacrificed slaves to insure a good harvest. The British Government decided to put a stop to it. A military expedition sent into the mountain fastnesses of these cruel tribes succeeded after some loss of life in freeing thousands of slaves. It makes a picturesque and absorbing story.

PHOSPHORESCENCE

Recent investigations into phosphorescent light reveal new and interesting facts about it; and what is more, they seem to point toward obtaining new insight into the structure of matter—its atomic makeup. Here is a subject for what we call a "typical SCIENTIFIC AMERICAN article." It will appear soon.

THEORY

From what peculiar primitive beginning did eyesight evolve a billion years ago? There is no direct proof, but according to one noted American eye specialist whose theory has been sent us, it evolved from the ancient ancestors of certain living amoebas. Given the same circumstances again, the descendants of these amoebas would again evolve sight.

NOBILITY

"Nobility at Work" is the misleading title of a forthcoming article about the so-called "noble" gas argon—also helium and neon. Argon is used for filling the newer electric light bulbs; helium for dirigibles, and neon for neon lamps. How these things "stack up" in commerce provides an unusually interesting—and surprising—account.

ENGINES

Have you ever thought of the human body purely as an engine? How would a modern donkey engine and hoist have fared in competition with a few hundred slaves and a corps of lashmasters in raising the pyramids of Egypt? Things like this form the text of a fascinating article by Dr. Paul R. Heyl of the U. S. Bureau of Standards. It will set you thinking.



A Troglodyte Woman and an American Oil Can!

Incongruous? Of course. But it is a thing you can see nowadays from one end of the world to the other, wherever backward or primitive people dwell. The lady is about to build a fire, and the oil can is her stove. *You* live where an empty oil can is simply an empty oil can—generally something to get rid of. *She* lives where an empty oil can is an oil can—something to be treasured. Go even to the innermost districts of China or India and you will find the same thing—the natives, in fact, are influenced in buying the oil by the fact that the useful can goes with the sale.

And what can not an ingenious native do with such a can? It makes the best kind of a receptacle, and for cooking it looks as if the white man had made it for that purpose. During the temporary primitive life in the World War trenches, cut-down oil cans of the same general sort—"petrol tins" the British "Tommies" called them—served as anything from bathtub to pot and kettle, and for trench stoves as well, just as the one in the picture is serving the troglodyte housewife. She must go outdoors to do her cooking, for her subterranean home has no chimney.



THE TROGLODYTE TOWN OF MEDENINE, IN SOUTHERN TUNISIA

Here the houses are built on the level plain, in the shape of huge loaves of bread, often in two or more stories

Troglodytes of the Desert

Mysterious Tribes of Northern Africa Live in Great Circular Wells. Others Burrow into Rocky Hills, Carving Out Spacious and Comfortable Dwellings

By HORACE D. ASHTON

Fellow of the Royal Geographical Society

THREE hundred miles in a direct line south of the site of ancient Carthage, in the hills known as the Matmata Plateau, there are upwards of 30,000 people whose dwellings are merely holes in the ground. Practically all their lives are spent under ground, and when they die they are brought up and placed in shallow graves on the surface.

These people represent a race that so far antedates the Arab in North Africa that its origin is lost in antiquity. Two thousand years ago, they were, no doubt, living a pastoral life in tents in the foothills, but the armies of

the Caesar, after bringing Carthage to her knees, swept south and so menaced them that they took refuge in the rocky hilltops where they dug themselves in between layers of rock and, placing bulwarks before the entrances to their caves, successfully

Some of these residences contain several chambers, always of the same dimensions, some opening from the main room, but often with independent entrances, except in the case of the harems or women's quarters. There is no furniture, the bed being, in most cases, a sort of platform or shelf in the far end of the room, about three feet above the level of the floor, but sometimes a separate platform made of wood, overlaid with white plaster. These are covered with many thick blankets woven by the women. In only one house did I see anything resembling a table, and that was in the

"What is a Troglodyte?"

Troglodyte means "to enter a hole." The troglodyte is a dug-out dweller, wherever he is. In the World War, one of the editors was frequently a troglodyte and, despite hard luck stories often told by other war veterans, he wishes he were again—minus the war! On an icy day a dug-out is warm; in midsummer it is cool. Do not pity the poor troglodytes—they get along alright.

—The Editor.



LIKE CATACOMBS

These curious dwellings at Medenine were clearly described by Sallust, 2000 years ago

withstood siege after siege until the Caesar's armies withdrew.

Today most of them live just as the invaders left them, for these refuge caves solved a great problem in the construction of houses where there is practically no wood. Utilizing one stratum of hard rock as a floor and the one above as a ceiling, they dug into the comparatively soft marl. Here they formed chambers whose dimensions are approximately 20 feet long, eight feet wide and with ceilings which form a perfect arch eight feet high—the whole finished off with a crude cement and whitewashed throughout.



TROGLODYTE FLAPPER

This picture was taken in one of the inhabited "wells" described in the article



HOW THE MATMATA TROGLODYTES LIVE—IN IMMENSE WELLS

In one valley, 12,000 people dwell in rooms that lead off from tunnels dug at the bottom of these broad holes

house of Sheik Mohamed Lafet of Durat. In his own room there was a small plain table upon which he kept his papers and some photographs which had been sent him by former visitors.

In all the rooms which are occupied, there are the usual divans along the side walls, upon which the people sit; for there are no chairs. In the women's quarters one finds the inevitable loom and numerous earthen bowls in which are prepared the *couss-couss* and other native dishes, and the huge jars which hold olive oil, dates, figs and other staple foods.

In front of each house is a stone-walled court yard which serves three main purposes: first, as a place in which

the women of the household may remain out of doors and still have their accustomed privacy (for these people are all Moslem and the women are veiled and secluded from childhood); second, as a sort of barnyard in which sleep all the goats, donkeys and chickens, and even an occasional camel, not to mention the ever-present and always ferocious watch dog; and third, as an individual fortress in time of siege.

THESE towns are usually dug into the conical, mesa-like hills of this region, which are composed of a succession of strata, sometimes to a height of 100 feet or more. The streets are arranged like terraces or huge steps, one above the other, and culminate in a *ksar* or citadel on the very summit. This served as a store house and a place of refuge in the frequent wars which prevailed until the arrival of the pacifying and enlightening French influence.

Looking out from one of these citadels across the vast intervening valleys toward the mountains opposite, the view greatly resembles that of the region of the Grand Canyon of the Colorado, for the erosion and coloring are very much the same. Especially is this similarity marked under a sunset sky, for then these red sandstone cliffs, seen through a varying blue haze, seem to recede to a greater distance and to climb to loftier heights.

These people are known as the "climbing troglodytes." There are, in addition, several districts within a radius of a few hundred miles where others of the same race live—branches, no doubt, of the same tribes. The dwellings of these related peoples re-

semble those of the climbing troglodytes only in the form and dimensions of the rooms. At Ksour Medenine and in the region of Foun Tathouine and at Guerca Oulad Dabet, houses have been built on the level plain, in the shape of huge loaves of bread, arranged in numerous horseshoe groups, and sometimes to a height of five or six houses, placed one on top of another.

This grouping is said to have originated from the necessity of defense against the Tuareg marauders who used to prey regularly upon these pastoral people, robbing them of their stock, grain and, often of their women.

The houses, each comprising a single room, are called *rhoorfa* and are used



BEAUTY RIDES

The young and pretty women ride on camel saddles. The older, and uglier ones walk



THE MATCHMAKER

At 102 she is still active. Such women usually engage in the matchmaking business



TROGLODYTE INTERIOR AT MATMATA

The bed is made of wood and covered with plaster. Note the huge jars in which are stored olive oil, barley and dates



WEAVING GOAT-HAIR TENTS BELOW GROUND

Two troglodyte women are preparing a loom to weave tents for those members of the tribe who herd flocks in the desert

principally as storehouses, although they sometimes house the old and feeble members of the tribes who are not sufficiently strong to endure the hardship of the semi-nomadic life led by some of the people; for here, fully 80 percent of the people spend nine months of the year roaming the desert with their flocks, planting and harvesting their meager crops as they go. The old folks stay behind and act as caretakers of the stores at home, awaiting the autumn home-coming. Then for three months the town is surrounded to a distance of half a mile on all sides with thousands of nomad tents.

Sixty miles to the west of Medenine is the strangest of all troglodyte towns, that of Matmata. This curious and primitive community is in a class by itself. The people appear to be of the

same race as those described above, but their dwellings are quite different, being huge wells which dot the whole valley as far as the eye can reach.

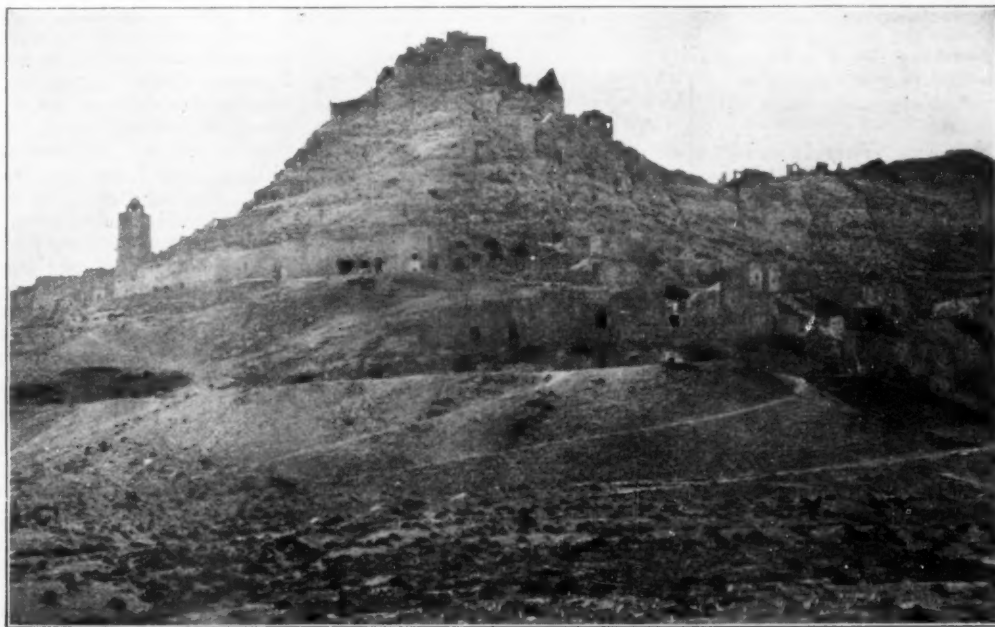
SURROUNDED on all sides by low mountains, on top of the loftiest of which can be seen their ancient fortresses and citadels, the valley of Matmata covers more than three square miles. It presents to the eye of the foreigner a most astonishing sight, for the whole floor of the valley is dotted with the openings of huge circular wells, about 60 or 70 feet in diameter, and about 30 feet deep.

In all the valley there are only three buildings—a school, a mosque and a market, and these have only recently been built by the French. Yet in this valley are said to dwell more than 12,-

000 souls without even a single tent.

These strange subterranean homes are entered through dark sloping tunnels, usually branching off into small stables on the way, and opening finally into a circular court yard, 30 feet below ground level. Around the vertical sides of this courtyard are dug the rooms of the occupants.

All of these troglodytes are most hospitable and kindly people and they extend the heartiest welcome to the visitor. Matmata and Medenine and even Fom Tathouine are readily accessible by automobile from Gabes in southern Tunisia, but the towns of the climbing troglodytes, Duirat, Chenini, Guermesa can be reached from Tathouine only by mule-back, as they lie in rugged mountains where there are only steep trails.



A DESERT HILL HONEYCOMBED BY TROGLODYTE DWELLINGS

In this locality many of the strata of rock are comparatively soft, so that the labor of excavating such terraced dwellings

as these is not extremely difficult. Most of the rooms dug into this hill are invisible from outside and are poorly lighted



SOME OF MIKIMOTO'S CULTURE PEARL DIVERS, OFF TAHOKU ISLAND, JAPAN

The divers are women, young and strong, who are better workers than men, because they are supposed to be able to stay longer under water. Each diver bears water-tight goggles on her forehead

Mikimoto and the Culture Pearl

Culture Pearls Show no Difference in Color, Form or Substance from the Native Pearl. How the Japanese "Pearl King" Grows them by the Millions

By PROF. DAVID STARR JORDAN
Chancellor Emeritus, Stanford University, California

ON the southeast side of the main island of Japan lies the large peninsula of Yamato, very mountainous and picturesque, one of the early homes of the Yamato or mountain-born race, which, whatever its origin (Assyrian, possibly, or Greek—as yet unknown) now dominates Japan. On the east side of this peninsula, stretching along the large Gulf of Owari lies the province of Ise, with its two considerable seaports, Tsu and Yamada.

A few miles beyond Yamada in Ise lies the fishing village of Toba, the chief town of the very small province of Shima, which now constitutes the *ken* or prefecture of Miye. Shima is a small hilly peninsula including the Bay of Ago with its cluster of barren islands, suggesting the rocky islets of Greece, but very different as to human surroundings. The water of the inlets of southern Shima (*Shimei-Ura*) is remarkably clear. The sea has a sandstone bottom and clean tributary streams, few in number, while its southern end lies wide open to the warm wash of the *Kuroshio* or Black Current, the Gulf Stream of Asia which sweeps northward from Formosa and Luzon.

In the southern part of the

Gulf of Owari it has long been known that a small species of pearl oyster (*Margaritifera martensi*) occurs in some abundance, and from time to time valuable pearls have been found. Thus, diving for pearls, and also for abalone, became one of the local industries of Toba, the work being mainly carried on by peasant women.

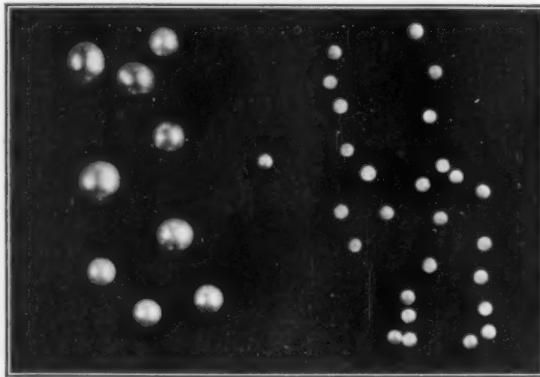
KOCHICHI MIKIMOTO, the "Pearl King," was born in Toba in 1858. His parents were in humble circumstances, and it is said that in his youth, with a push-cart, he peddled

persimmons, *tofu* (soya-bean cheese) and the like on the streets of Yamada and Toba. Mikimoto was a young man of unusual intelligence and industry and early acquired some local prominence as member of the assembly of Toba.

In 1892, at the National Exhibition in Tokyo, Mikimoto received a prize medal for an exhibit of pearls. The Japanese people set little value on pearls, (*shinju*) or on other jewels, but the foreign trade maintained a continuous demand. In 1890 he began, on Tahoku Island, in Ago Bay, to the seaward of Toba, the culture pearl industry.

It was known that in China, pearls had long been secured from fresh-water mussels by some form of artificial stimulus. Any object placed within the "mantle" of the mussel would cause irritation and the foreign object would be imbedded in a nacreous or pearly covering.

Professor Kakichi Mitsu-kuri, of the Imperial University of Tokyo, then in charge of the National Exposition, gave to Mikimoto the suggestion of experimenting on artificial stimulation which might greatly increase the number of pearls in a given area. Dr. Kamakichi Kishinouye, a grad-



NINE CULTURE PEARLS

The single pearl in center is a natural pearl; those on left are culture pearls from Tahoku Island; those at right are mother-of-pearl fragments as introduced into oysters as the basis of culture pearls. All are shown in natural size

uate student, now professor in the Imperial University, and Chujiro Sasaki, then a young professor interested in conchology, gave valuable help.

The ordinary pearl is a product of irritation due to the presence within the mantle of the pearl oyster of some small sea-worm or minute crustacean which has crawled into the shell. A pearl has been described as "a sarcophagus of a worm untimely dead." Any irritating object, as a grain of sand, may serve as a nucleus for a pearl.

Tahoku is a small, rocky islet in Ago Bay, about 18 miles to the southward of Toba. On and about this island Mikimoto established in 1890, the first pearl-oyster farm. Four years were devoted to experimentation, for some time with discouraging results. The earliest pearls were flattened or imperfectly spherical, a condition slowly improved and finally fully remedied in 1913.

According to a recent circular issued by Dr. Sasaki and others, the latest investigations show: "The theories of the formation of pearls have been the subject of study and discussion among scientists for centuries. Some thought that a grain of sand becomes the nucleus of a pearl, whereas others believed that internal pathological conditions produced the pearl; still others advocated the theory that the pearl is formed by the presence of parasites. All maintained their own views and there was until recently no one theory which could be accepted by many, if not by all. The latest theory, which is generally accepted, is the theory of the pearl sac formation in pearl oysters.

"THE nucleus of a pearl need not be any particular substance. It may be a grain of dirt or the larva of some parasitical worm or some other similar substance. For example, a small crustacean was found to be a nucleus. In some cases there was no nucleus at all. Therefore, from these facts we can say definitely that the nature or characteristic of a nucleus or the presence or absence of it is not



KOKICHI MIKIMOTO

The "pearl king" of Japan. It was he who developed and perfected artificial pearl culture from a very small beginning

essential for the formation of a pearl; the essential element is the pearl sac which induces the secretion of the pearl substance as connective tissue. Now, it became evident that the pearl sac is formed from the epidermis, and not from any foreign substance; that is to say, the pearl sac is formed from a portion of the epidermis cell of the mantle-parenchyma which is detached and falls on subcutaneous tissue. All natural pearls originate from the pearl sac, whether the causal stimulus for the formation of the pearl be external or internal, the pearl substance being secreted by the layer of epidermal cells of this sac. The function of these cells is precisely that of mantle-parenchyma cells."

Seventeen patents have been granted to Mikimoto for details in producing pearls and for hatching and caring for the "spat" or young pearl oysters. The latest Japanese patent (No. 33,640) describes the method as follows: "The process consists of removing from a living oyster the mantle-parenchyma which is used as a bag to envelop the nucleus of the pearl. When this nucleus, which consists of a fragment of fresh-water mussel, has been inserted in the fleshy bag, its mouth is secured

with a cord, and the whole is introduced into the subcutaneous tissue of the shell-secreting epidermis of another oyster through an opening surgically made for the purpose. In the same operation the cord is withdrawn, the wound made by the lancet is disinfected, and the oyster having been returned to the sea is left to cover the nucleus with the many layers of nacre necessary to produce perfectly spherical pearls.

"THIS process," the Sasaki circular continues, "is extremely delicate, and unless done by selected technicians the work cannot be performed successfully. When this method was published by the Patent Office, it was believed, at least by some Japanese, that the technique of tying the mouth of the bag formed by the mantle-parenchyma would be too delicate and almost impracticable. There were certain European scientists who also held the same opinion. The actual performance of the delicate operation at the hands of expert technicians created general surprise. The pearl oysters after being so treated are left for several years in the nursery. Out of 50 oysters picked out of the bed at random, on an average 13 contain perfectly round pearls. After careful examination of these pearls, the committee came to the conclusion that they were in lustre, color and shape, and in every other way, equal to natural pearls. The attainment of this remarkable success is solely dependent on the application of science."

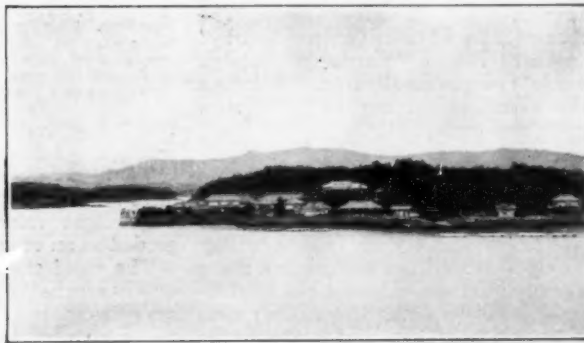
It was the fortune of the present writer, in November, 1922, to accept an invitation from Mikimoto, to visit Tahoku. An account of this trip was published in the *Scientific Monthly* for October, 1923. This record I condense here:

An automobile met us at Toba. My associate on this trip was Dr. Senzj Yamamoto, lecturer on genetics at the Imperial University of Kyoto, who was then helping me to complete my third collection of Japanese fishes. We left Toba on one of those perfect days



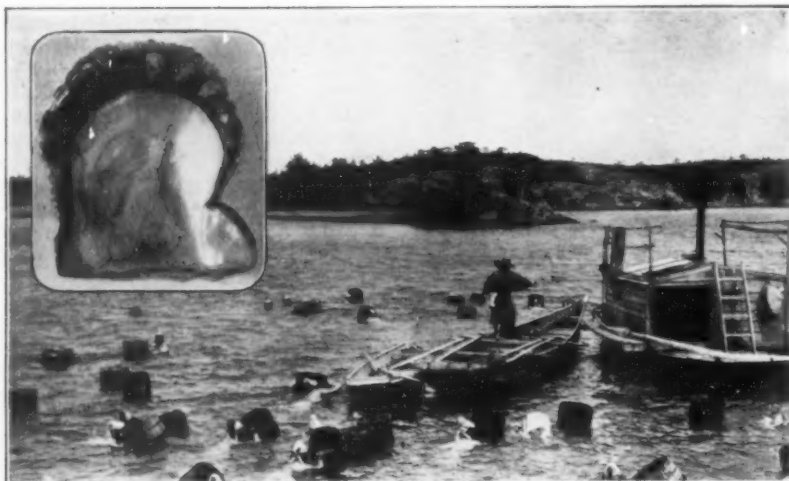
GOTOSHO, SHIMA, JAPAN

A typical pearl-fishing village in the peninsula of Shima, now the center of the operations of Mikimoto. The region described by Professor Jordan lies about 300 miles southwest of the city of Tokyo



TAHOKU ISLAND, AGO BAY

On this island Mikimoto began his culture pearl industry. It has subsequently been extended as far as Japan's southern tip, eight other localities along the indented coast now furnishing culture pearls



PEARL DIVERS AT WORK OFF GOTOSHO

Compare with the picture at top of page 300. The divers are swimming near the boat, with their tubs ready to hold the oysters recovered. Insert: Shell of a Japanese pearl oyster, half size

which come only in November and even then but seldom. After 15 miles of narrow roads through hills ablaze with maples, we reached Ago Bay. Here Mikimoto met us with what was literally a steam tub, almost as broad as long, with no deck, its interior fitted with easy chairs. It was propelled by a little engine, adequate in good weather for the few miles between Tahoku and the mainland.

Having leased this picturesque island as a base of operations, Mikimoto has secured the rights to about 50 miles of bay around it. A portion of this area is given to the spat. Small stones are scattered over the bottom, and to these the newly hatched fasten themselves by a byssus or set of threads. These are left to grow for about three years. They are then gathered, and under the mantle of each one is introduced a very small round fragment of shell (mother of pearl). These are then transferred to the south side of Tahoku into water so deep (30 to 40 feet) as to prevent all danger of freezing. The animals are "planted" about a foot apart and held for some five years more, when they are brought up by the divers, nearly every one having then a pearl of some value. The market price of these "culture pearls," (*yoshoko shinju*, "pearls for foreign trade") ranges usually from 200 dollars downward, according to their size, form and purity.

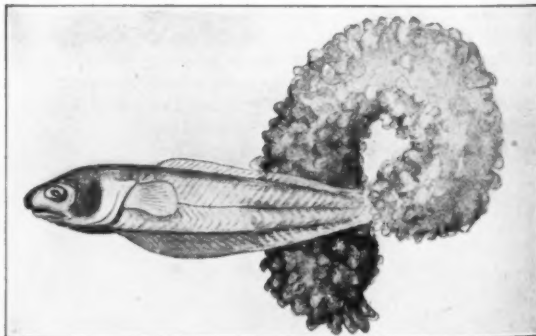
SINCE the establishment of the industry on a firm basis, and spherical pearls can be counted on, Mikimoto has extended his work from Ago Bay to eight other bays and islands along the coast to the southward, the southernmost localities being Omura Bay near Nagasaki and Yayeyama Island, in the Riukiu Archipelago. Certain inlets in Hawaii have been under examination, and there are bays probably available

in the peninsula of Lower California.

The total area of Mikimoto's water farms amounts to 40,380 acres. Eighty buildings are now occupied and a thousand people are employed. Three millions of oyster-spat are planted each year, and upward of a million pearls secured. Those not spherical, or which are otherwise imperfect, are destroyed, that the reputation of the culture pearl shall not be harmed. As there is no difference whatever in color, form or substance between the native pearl and the best culture pearl and as they cannot be told apart except by dissection, there is no reason why the price of the culture pearl should be lower than that of the other. There is no difference except that Mikimoto is honest in regard to his product. I may note here that the conventional "artificial pearl" commonly used in neck-

AN ODD RESIDENCE

A peculiar example of symbiosis—a pearl fish which lives in a sea cucumber. It is said to place its tail opposite the opening, wriggle its way inside, backwards, and rest there. This figure shows one coming out. Sometimes, near Panama, these fishes live in the shell of a pearl oyster, hence the name "pearl fish"



laces is made from fish scales and has very slight value, although well regarded as an ornament.

The chief enemies of the pearl industry are the "red current" (*Akashiwo*) and the octopus. The "red current" is made up of prodigious swarms of a minute flagellate infusorian that come up at times from the Philippines. When the red water invades Ago Bay, the

culture cages are removed to places which the current cannot reach. Species of octopus are the most dangerous of all larger enemies, sometimes destroying the entire stock of inoculated oysters. To shut out these and other predatory creatures, Mikimoto has devised patented culture cages.

THE pearl divers (*ama*) at Tahoku form an interesting group. These are all young women from 18 to 35-years of age, vigorous and muscular. It is said that the profession has become hereditary in the province of Shima. Women are preferred to men for this work, as it is claimed that they can stay under water longer (two to three minutes). Their husbands find employment in taking care of the shells and pearls and in other duties about the island. Mikimoto's divers wear cotton suits not unlike pajamas, white cotton caps and over the eyes a large water glass for better vision. Each one as she dives from the boat has with her a floating tub in which to deposit her "clutch." In the interval between plunges the divers keep up a sharp whistling, a process which is said to give them lung strength for their work.

The salt water tends to coarsen the skin and to redden the hair, but the women seemed unusually robust and in their way not unattractive. Like all other Japanese, they are endlessly good natured, and when we left the island, after they were back in *kimono* and *obi*, they said "*Sayonara*" (good-bye) in the friendliest fashion, waving their handkerchiefs until we were out of sight. These women are in their way aristocrats among the divers.

The harvest season for pearls is in early December, but Mikimoto sent out for our edification nine of the divers, each one bringing in a pearl

oyster. Opening these in his summer house on the hill, a pearl was found in each one. Two of the oysters were fried for my luncheon, and in one of these (very delicious, by the way) I found a minute natural pearl. Our visit ended, Mikimoto gave the whole pearl catch of the day as a present to Mrs. Jordan, a friendly souvenir of a delightful and instructive visit.



THE BUILDER OF THE CAVES

Baldassare Forestierre has labored long and strenuously in building his unique underground residence and fruit farm



THE ENTRANCE FOR AUTOMOBILES

Cars can be driven through the underground passageways. The caves are located under the orchard shown at the right



FREE FROM THE SUN'S GLARE

The rocks and arbor form a charming entrance to the grotto, where the temperature is found quite constant and pleasant



GROWING ORANGES UNDERGROUND

This orange tree is growing healthily underground. Many other species of fruit trees are to be found in these caves

A Modern Man-Made Cave

The rock-hewn tombs of Palestine and the catacombs of ancient Rome are visited by all tourists, but few people are aware that near Fresno, California, we have a modern counterpart. A series of 60 underground rooms have been excavated as a refuge from the summer heat and for the regulation of the ripening and drying of fruit. This series of grottos now covers an area of ten acres. It underlies an orchard of oranges, peaches and figs and vineyards. Baldassare Forestierre, the builder, is a native of Italy, who came to America years ago and obtained a ranch of 70 acres near Fresno. Here he began the building of the caves, a task to which he has devoted most of the past 20 years. He has worked steadily and lived in this unusual residence, doing only enough ranch work to provide a livelihood for himself and funds for his project. Today he has a place unique in the western world and comparable only with the famous wine cellars of France and of his native Italy. He now plans to double the size of his underground retreat, making it 120 rooms. It will include, if his dream is realized, a hotel, restaurant,

garage and dance hall—a miniature dream-city beneath the surface of the ground. Some parts of the caves are already two stories beneath the surface and are accessible not only on foot, but by automobiles, which may be driven down an artistic driveway lined with orange trees in beautifully constructed niches. Forestierre, a natural horticulturist, has experimented with all kinds of trees and grape vines not only on the surface but beneath it as well, so that one of the wonders of the place is the sight of orange, lemon and grapefruit trees growing sturdily two stories beneath the level of the state highway. Light and air for these subterranean trees are admitted through holes in the domed ceilings which open upon the ground and through which sufficient sunlight streams for healthy growth. In other sections of the caverns where light without sunlight is essential, the openings are cunningly shaded by grape vines. Outside the temperature may vary from 30 degrees in mid-winter to 110 degrees in midsummer, but underneath the temperature never goes below 55 degrees in winter or above 80 degrees in summer.

OUR POINT OF VIEW

LEONARD WOOD

THE untimely death of General Leonard Wood, Governor-General of the Philippines, has removed one of the ablest and most sincerely beloved public men of America. His life during the past 30 years was that of a great soldier, an administrator of consummate ability, and an outstanding American whose record, in spite of the fierce light of publicity which always beat upon it, stands today without a blemish.

During a period which witnessed our emergence from voluntary national isolation to a commanding position among the great peoples of the world, General Wood always exercised a far-reaching, constructive influence. The briefest recapitulation of his activities establishes this fact. After serving as Colonel of the regiment of "Rough Riders" during the Spanish war, he was appointed Governor of the Province of Santiago, and then Governor-General of Cuba. Such was his executive ability, that he brought order out of chaos, organizing a stable government, and making it possible by 1903 to turn over a prosperous and peaceful country to the Cuban people. This work included the complete reorganization of fiscal, judicial, provincial and municipal affairs, and the organization of military and police forces. Soon thereafter, he was sent to the Philippine Islands as Governor of Moro Province, where he repeated his successes in Cuba.

Later, we see him appointed Chief of Staff. In this most important position he served for four years, during which he completely reorganized the General Staff. He will be gratefully remembered as the originator of our training camps. Later, at a time when the White House frowned upon even the suggestion of military preparedness, General Wood was the only high-ranking military officer who jeopardized his military future by throwing himself heart and soul into the organization and development of the famous Plattsburgh camp. It took patriotism and courage of a high order to do that, and General Wood subsequently paid the price. When the war was declared, it was the national expectation that this most able man would be given a large share in our military activities in France. Instead of this, he was retained in America, moved from pillar to post, and forbidden to accompany to France the division which he had trained.

His last great work was that of bringing order out of chaos in the Philippine Islands—a stupendous task, which in spite of his age and somewhat broken health, he did not hesitate to under-

take. He found the Philippines hostile and left them friendly.

The writer closes this eulogy by quoting from a personal letter received from the Governor-General. "The people are happy and contented and on the whole, I think, appreciative of what we are doing. Despite all the efforts of the leaders, the lies by Philipinos against Americans, and the dissemination of false information both here and at home, I have yet to receive my first disagreeable signed or unsigned communication from any one of the twelve million people living in the islands."

NAVAL CONFERENCE DISARMED

WHEN the "naval experts" (how weary one becomes of that pet term of the propagandists) had become deadlocked at Geneva, and the prophets

New York's Airport

IN Governor's Island, situated off the tip of Manhattan, nature has provided an ideal airport for New York City. To build an airport many miles from the business heart of New York would be to rob the air service of that very time-saving which constitutes its chief, its only, advantage over train service. Of what value is a saving of three hours in the air, if two hours of the three are lost in journeys by land between flying field and city?

The commission which is making a study of the problem should place this question of time-saving far in the lead of any other considerations. If Governor's Island fulfills all other airport conditions, physical and commercial, and it does, its choice as the seat of the most important airport in the United States would seem to be inevitable.

of calamity were predicting another "armament race," the peoples of the United States and Great Britain took hold of the situation and set it in its true light.

"We regret," they said, "that these naval gentlemen are unable to agree on the technical details, but their failure can have no serious effect upon the excellent understanding of two great nations, between whom war is simply unthinkable." Thus the public has disarmed the Conference.

Another happy result is the conviction that the discussion has cleared the air, and prepared the way for further diplomatic handling of the problem.

Briefly put, it may be said that the

United States and Great Britain are agreed upon parity, but that the former favors big ships armed with big guns, and the latter prefers a large number of smaller ships armed with lighter guns. This is due to the wide difference in the naval requirements of the geographically self-contained United States and the widely scattered elements which make up the British Empire. Surely a parity can be arrived at which will satisfy both conditions. For ourselves, we must balance our navy by building additional cruisers.

EUROPEAN AVIATION IMPRESSIONS

AFTER spending a few weeks in visiting European flying fields, the writer feels that although the network of air lines in Europe functions with extraordinary regularity and safety we in America are liable to praise unduly the superiority of commercial aviation in Europe.

If commercial aviation means a profitable air service, then, strictly speaking, there is no commercial aviation there. The great German *Luft-Hansa* derives from its traffic returns only about 50 percent of its running expenditures. The British Imperial Air Service receives a subsidy of 50 dollars for every passenger it carries. In strong contrast to military aeronautics, commercial aviation in France is at a very low ebb.

In the United States, the mileage flown on the regular air lines is now almost equal to the mileage of the entire European continent. Subsidies are debilitating, and the United States very wisely is helping the industry, not by subsidies but by providing lighted airways, weather reports and wise air regulation.

It is unnecessary to say that we have excellent pilots in the United States. The recent transatlantic flights prove that. Our commercial pilots have graduated mainly from Army and Navy ranks. Although our commercial flying schools are doing good work, teaching the men to solo and giving them some ground training, they wish to convert their students into a more thoroughly finished product. Therefore, the present cooperation between flying schools and the Army Air Corps Reserve will do much to improve the situation. We can learn much from the *Deutsche Verkehrsfliegerschule* in which men are trained, not only as fliers, but as engine experts, meteorologists, navigators, and are given over one hundred hours in the air before they are allowed to join the *Luft-Hansa* as assistant or apprentice pilots only.





ELIZABETH BRIDGE TO STATEN ISLAND

Staten Island is cut off from the mainland by navigable channels known as the Kills. These have been dredged to accommodate a large fleet of ocean-going vessels. Hitherto, passenger travel has been by ferries; but the Port Au-

thority is now constructing three important bridges—two cantilever structures and one arch bridge. Above is the Elizabeth-Howland Hook cantilever bridge. Total length of the cantilever is 1152 feet. The center span is 672 feet

Placing Staten Island on the Map

Building Three Bridges that Will End the Isolation of an Important Section of New York City.

By J. BERNARD WALKER

IN view of the rapid growth of New York City and its residential suburbs, one is puzzled to find an adequate reason for the sparsely-populated condition of Staten Island, and the failure to tie in this most attractive region with the general transportation system of Greater New York. Long Island, the Bronx, and New Jersey are connected with Manhattan Island by a score of costly bridges and tunnels, many of which, in respect of their magnitude and carrying capacity, are unequalled elsewhere. But Staten Island has been

treated as the "poor relation," and not a rapid-transit bridge or tunnel crosses its encircling waterways.

Her isolation, fortunately, is now about to be broken, thanks to the "Comprehensive Plan" of the Port Authority, under which, within a year or two, the stretches of water known as the Kill van Kull and the Arthur Kill will be spanned by two large cantilever bridges, and a few years later by an arch bridge which, with a single span of 1650 feet, will equal the length of the great bridge which is now under construction across the harbor at Sydney, Australia. These two will be the longest arch bridges in the world.

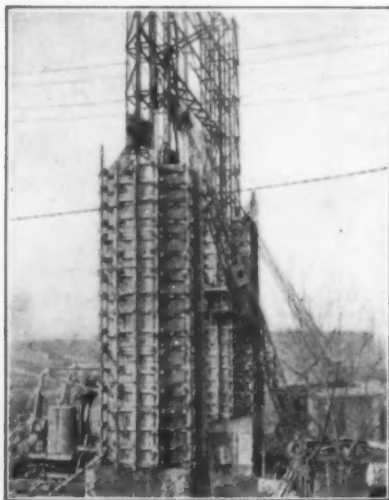
STATEN ISLAND is separated from New Jersey by the Kills, one of the most important waterways within the Port of New York. They are together about 12 miles in length, and the width varies from a few hundred feet to nearly 2000. They have been dredged so as to accommodate deep-draft ships, and the commerce through them is today very heavy.

The agitation for a bridge has been carried on more or less vigorously for a century past, and the movement has been brought to a head largely because of the increasing use of automobiles and motor trucks.

It will be remembered that a few years ago, under Mayor Hylan's administration, there was much discussion of a proposal to build a tunnel from south Brooklyn to Staten Island, on a location slightly to the north of

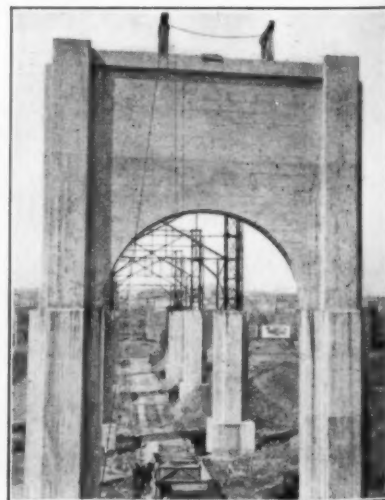
the Narrows. This was to have been used both for rapid transit and railroad freight service. Two large shafts were sunk, but no attempt was made to drive the tunnel.

The fact that the state line between New Jersey and New York ran through the Kills constituted in itself a formidable political barrier to bridge construction; but in 1924 the legislatures of New York and New Jersey removed this obstacle by directing the Port Authority, which is a bi-state body acting as the agent of both states, to build, operate and



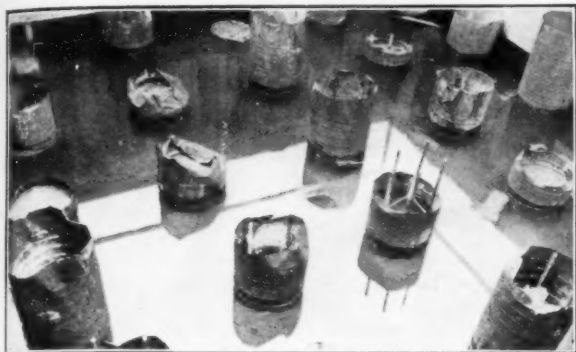
REINFORCED CONCRETE PIER

Some of the piers of the approaches are founded on wood piling and others upon reinforced-concrete spread footings



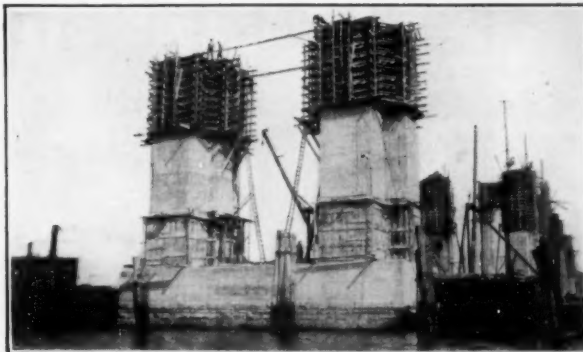
A COMPLETED PIER

Piers of the approaches to the Elizabeth Bridge, built of reinforced concrete, are simple and pleasing in appearance



OUTERBRIDGE APPROACH PIER FOUNDATIONS

The foundations for the new bridges presented no serious problems, although the substructure varied. The above view shows a set of massive reinforced-concrete piles, sunk to rock for carrying a heavy pier



ONE OF THE CANTILEVER PIERS

The cantilever section of the Outerbridge Crossing measures 1500 feet, and is made up of a center span of 750 feet and two shore spans of 375 feet each. Above is shown construction of one of the main piers

maintain two bridges, one from Perth Amboy, New Jersey, to Tottenville, Staten Island, and another from Elizabeth, New Jersey, to Howland Hook, Staten Island. Each bridge is designed for highway traffic only, and each will carry a four-lane vehicular roadway and two five-foot sidewalks on a single deck.

The bridge from Perth Amboy to Tottenville is to be known as the Outerbridge Crossing, in honor of the first chairman of the Port Authority. Twelve miles or so from this is to be the Elizabeth-Howland Hook bridge.

In order to attain the maximum clearance of the floor of the Outerbridge Crossing bridge above the water-way, without exceeding the maximum roadway grade of four percent, and because of topographical conditions, a bridge of great length was necessitated, the total length, includ-

ing approaches, being about 10,200 feet. The bridge crosses the Arthur Kill as a high-level cantilever structure. The central span of 750 feet has a clear height above water of 135 feet. At each end of the cantilever structure is a 375-foot through-truss span.

THE main river structure is supported by arched concrete piers which, as may be seen from our illustrations, give an impression of solidity combined with dignity and simplicity of outline. The bases of the piers rest upon timber piling, all of which was driven down until the desired resistance to carry the load was secured.

The long approaches consist of lighter, arched, concrete piers similar in form to the main river piers, carrying simple, plate-girder spans. These approach piers are carried in some

cases on timber piles, in others on reinforced concrete piles, and elsewhere on spread footings. The concrete piers are steel reinforced, and reinforcement is also used in the spread footings. For much of the distance, the approaches rest on firm soil, close to the surface. The total cost of the Outerbridge Crossing, it is estimated, will be approximately 10,000,000 dollars.

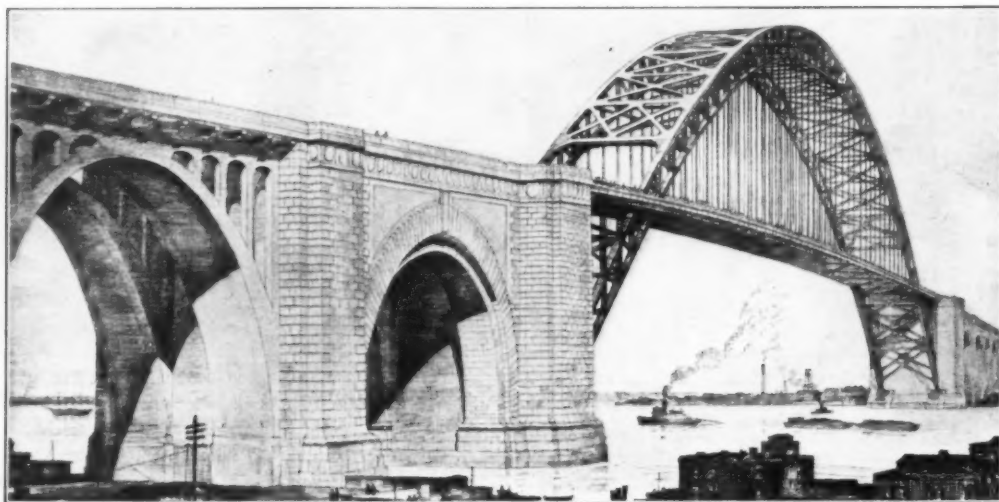
The Elizabeth-Howland Hook bridge will extend from McKinley Avenue in Howland Hook, Staten Island, to Edith Avenue in Elizabeth, New Jersey. The main portion of the bridge, which will be of the cantilever type, consisting of a central river span and two shore spans, will be a high level structure with an overall length of 1152 feet, and a center span over the channel of 672 feet. There will be a clear height from the



THE OUTERBRIDGE CROSSING

The Kill van Kull and Arthur Kill waterways separating Staten Island from New Jersey are from a few hundred to 2000 feet wide. Because of the heavy waterborne traffic, high-level bridges were necessary to

permit passage of ocean-going ships. The cantilever section of the Outerbridge structure is 1500 feet between the shore piers. The total length of the bridge, including the approaches, will be 10,200 feet



THE BAYONNE-STATEN ISLAND ARCH

It is only of late years that the arch has been recognized as being suitable for bridges of long span. Formerly, bridges of exceptional span, such as those across the East River, were built on the suspension principle. The first arch of great size for heavy traffic was the Hell Gate Bridge, 1000 feet long. The above bridge will be 1650 feet in length

water to the under side of the floor of 135 feet. The central span will be long enough to clear the whole width of the stream from bank to bank.

IT will be agreed, on looking at our illustration, that the bridge, with its long approaches carried on reinforced concrete piers, will present an imposing and pleasing appearance. The approaches will consist of plain girder spans carried on reinforced arched concrete piers similar in design to those employed in the approaches of the Outerbridge Crossing. Fortunately, bedrock at the crossing is close to the surface, and all the piers of the main river bridge will be carried down to this rock. The cost of the bridge is estimated at 6,584,000 dollars. The total cost of these two greatly needed and important crossings to Staten Island will be between 16,000,000 and 17,000,000 dollars, a sum which, in view of the great benefits that will be derived, would seem to be reasonable.

In considering the questions of future travel and revenue, the Port Authority made elaborate calculations as to the amount of traffic which would use the two bridges, and the amount of tolls that would be collected. These calculations were no mere guess, but were based upon a careful count of the traffic using the existing ferries from New Jersey to Staten Island, and also upon an estimate of the amount that would materially be diverted to the new structures as soon as they were available. It was estimated that traffic on the Outerbridge Crossing would be as follows: In the year 1928 there will be 1,058,600 vehicles, 3,261,000 passengers in vehicles, and 2,958,000 pedestrians. It is believed that there will be a steady increase as the years go by, and that by 1940,

3,104,400 vehicles carrying 9,562,000 passengers will use the bridge, and that the total number of pedestrians will have amounted to 6,125,000. The estimate for the Elizabeth-Howland Hook bridge for 1928 are: 897,000 vehicles, 2,361,000 passengers, and 2,074,000 pedestrians, and it is expected that by 1940 the figures under these three heads will be, respectively 2,991,000 vehicles, 7,886,000 passengers, and about 4,000,000 pedestrians.

ESTIMATES of Outerbridge bridge tolls based on a 60-cent-per-vehicle rate, showed that a return of 7.35 percent would be reached in 1940. The estimates for the Elizabeth-Howland Hook bridge at the same rate of toll are higher, starting in 1923 at 8.98 percent, and reaching 32.49 percent in 1940.

A third and far more important bridge, in point of size and capacity, is to be built across the Kills from Bayonne to Staten Island. Preliminary studies to decide what type of bridge would be most suitable to the site and the prospective traffic indicated that a single steel arch, 1650 feet in length, would not only be lower in cost than a cantilever or a suspension type, but that it would have superior esthetic merits. Sufficient borings were taken on each side of the Kill van Kull to establish the fact that good rock foundations are available.

It is only of late years that the steel arch bridge has come into its own, as a suitable type for bridges of exceptional length of span. Engineers will remember the unfeigned astonishment some 35 to 40 years ago, when Max M. Ende, a well-known engineer, showed designs for a steel arch to span the Hudson River, as being preferable to Lindenthal's designs for

a suspension bridge; and it was not until nearly two decades later that the Niagara Gorge was spanned by a steel arch bridge of the then unprecedented length of 800 feet.

Today it is recognized that cantilevers may be built up to 2000-feet span, steel arches up to 3000 feet and suspension bridges up to 5000 feet, or even more, if the conditions call for it. The arch has the great advantage that it is self-contained; whereas the suspension type has to be extended on each side beyond its central span, and the enormous pull of its cables must be taken up by massive anchorages placed far in-shore.

The longest arch today is found in the crossing of the massive four-track railway at Hell Gate in the East River. This has a span of just under 1000 feet between the end pins of the arch. A bridge of the same general type is being built across Sydney harbor, Australia, which will provide for vehicles, trolley cars, and railroad transportation.

THE great arch of that bridge has a span of 1650 feet, and the same length has been adopted for the Bayonne-Staten Island bridge, which will provide, at first, a four-lane vehicle roadway, with provision for the addition of two additional lanes when it shall become necessary. The roadway will be suspended from the arch by tension members attached at the panel joints of the arch. Preliminary estimates of the traffic are: 1,560,000 vehicles and 113,500 pedestrians in 1932, and 8,380,000 vehicles and 380,000 pedestrians by the year 1950. In the first year it is estimated that the net operating income will be 6.90 percent of the cost of the bridge and that by 1947 it will have risen to 33.8 percent.

On the Trail of the Molecule—I

A Number of Most Interesting Experiments in Physics Which May be Tried by the Amateur Scientist

By S. R. WILLIAMS, Ph.D.
Professor of Physics, Amherst College

WE are going to assume that everything in the room in which you are sitting has the power to increase in size and we will let the molecules of air which we breathe expand until they are about the size of the small clay marbles with which our boys play.

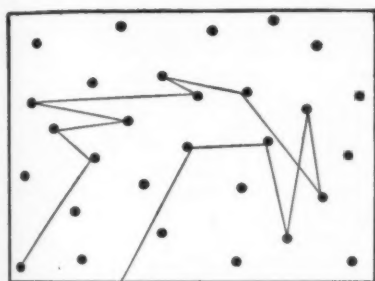


FIGURE 1

The possible path of a dancing, zig-zagging molecule of air for a short interval of time

This will mean a one hundred million fold increase in their size.

An amazing picture will be presented to us as we view these enlarged molecules. We will see them darting hither and yon, some with great and others with slow speed, but all constantly on the move. Some will strike others with a glancing blow; some will collide head on. They will rebound, ricochet and whirl through space in every conceivable direction and course. This is the eternal dance of the molecules.

On one of these perpetually moving molecules we will dab a small amount of red paint so as to follow it on its exceedingly crooked and devious trail. (Figure 1). It will make a straight path for a few moments, then glance off and start in another direction.

steam, or any other hot object, they will rebound with greater velocity and hence with more energy than that with which they struck it. In the course of time all the molecules in the room will be moving with a greater average speed than they had before turning on the steam and the average speed of the molecules becomes a measure of the temperature of the room.

THIS will be true not only of the molecules in a gas but also in a liquid and in a solid, except that in a solid there is no migration of the molecules. The higher the temperature of any body, the more vigorously do the molecules dance their eternal dance. At absolute zero their motion ceases altogether.

This constant motion of small particles due to thermal agitation can actually be seen under normal conditions by observing what is known as the "Brownian movements." Very small particles of matter such as lycopodium powder or carmine are mixed with water and observed under a high-powered microscope. The smallest particles will be seen to be going through motions quite similar to those shown in Figure 1. These motions are explained by saying that the molecules, as they dance helter-skelter, bump into larger pieces and so jostle them about in a similar fashion.

This ability to visualize and see in our mind's eye the behavior of an individual molecule has been productive of some very great advances in our knowledge of the movements of molecules *en masse*. Thus in the flow of gases and liquids it will help tremendously in understanding the phenomena observed if we focus our attention to one particular molecule and

A in Figure 2. The amount of fluid which passes the cross-section at B must be the same as that at A, otherwise there would be a loss or a gain at one point or the other. If the amount passing these two cross-sections per unit of time is the same for both, then it is evident that if we observe our molecule with the red paint on it as it passes B and A we shall see that the velocity is greater at A than at B. This can occur only when the molecule has its speed increased in going from B to A, or is "accelerated," as we say in physics, which means that the pressure on the side of the molecule toward B is greater than on the side toward A. This is saying that the pressure at A is less than at B.

Wherever there is an increase in velocity of flow in a gas or a liquid due to a constriction, or the equivalent of a constriction, at that point the pressure is reduced.

This is a statement of what is known as the Principle of Bernoulli.

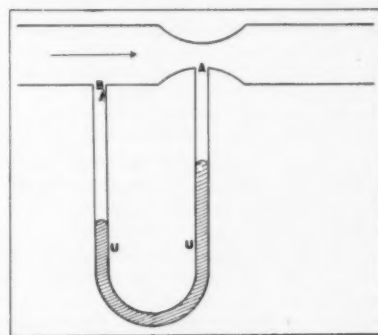


FIGURE 3

A form of Venturi meter. It demonstrates that the pressure is less at A than it is at B

In a very extensive study of hydraulics, Daniel Bernoulli, (1700-1782), established the principle that the pressure in a fluid when at rest is different from what it is when in motion.

To come back to our picture of the molecules of air the size of marbles, if all the openings in the room are closed, the air will settle down and be at rest except for the perpetual motion of the individual molecules due to temperature. The pressure of the atmosphere, due to its weight, we measure by means of a barometer, and the reading of the barometer will be a definite value while the air is at rest. But suppose the windows are opened and the

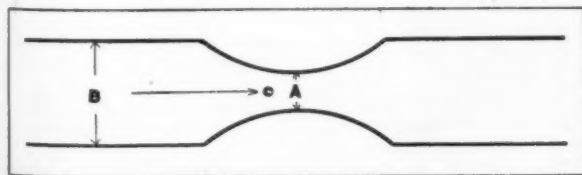


FIGURE 2

Flow in constricted tube. Moving from A to B, molecule is accelerated. Hence there will be a lower pressure at the point A than at point B

Again it strikes head on and rebounds along its former path, only to glance and ricochet over all sorts of other paths. Eventually it gets to all parts of the room by just zigzagging here and there as shown in the diagram.

If in their career these molecules should strike the radiator heated by

see what forces are acting upon it and how it moves under the influence of those forces.

Let either gas or water flow through pipes which have portions smaller in cross-section in one point than in others. That is, to illustrate, there is a constriction in the tube as shown at

air is allowed to blow vigorously through the room. Then the pressure as recorded by the barometer will drop. It will be found as it was found by Bernoulli that the pressure in quiet air is greater than in moving air. The first is called hydrostatic pressure and the second hydrodynamic pressure, and the distinction between these two

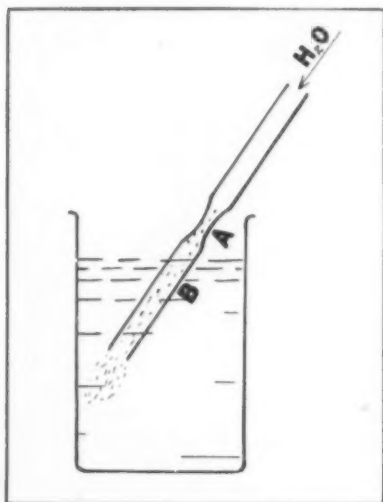


FIGURE 4

Reduced pressure at A releases air in the water in small bubbles, making it appear turbid for a short length of time

types of pressure was a very important discovery. The principle of Bernoulli may be stated in another way:

If, in the steady flow of a liquid or of a gas, a difference in velocity exists between any two points, it will be found that the pressure is least at the point of greatest velocity.

This very important principle discovered by Bernoulli explains some very interesting and at times startling if not paradoxical phenomena. In the case of the constricted tube shown in Figure 2, the difference in pressure between B and A may be demonstrated by the apparatus shown in Figure 3. A glass tube, three fourths of an inch to one inch in diameter,

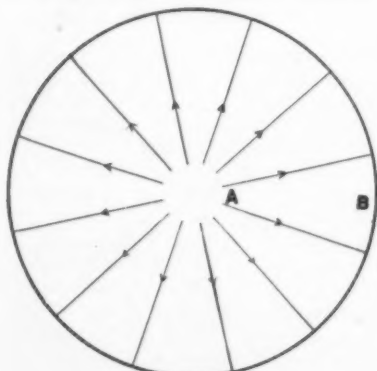
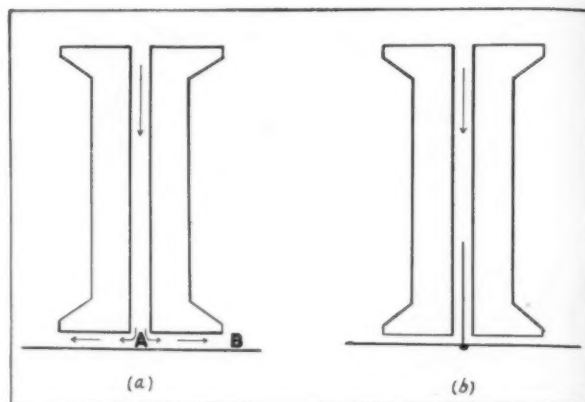


FIGURE 6

Showing the radial flow of a fluid between the disk and the spool in the disk paradox

FIGURE 5

The disk paradox, in which a disk (at bottom) actually appears to be pulled toward a jet of air shot at it through the hole in a spool. The harder one blows, the tighter the card will be pressed against the end of the spool. Try it



is drawn out to form a constriction at A. Another glass tube, one fourth of an inch in diameter, and bent in the form of a U tube, is sealed on at the points A and B and partially filled with a colored solution or with mercury. By blowing through the large tube in the direction indicated by the arrow it will be seen that the solution or mercury at UU will rise in the A side and fall in the B side, thus showing that the pressure is least at A where the velocity is greatest and that the higher pressure exists at B where the velocity is least.

The instrument shown in Figure 3 is the essential part of a Venturi meter which is used largely as a water meter, although it may be used in measuring the rate of flow of a gas. In order to use it as a meter, the difference in height of the columns in the U tube must be expressed in terms of rate of flow.

DYNAMICALLY it is the same problem whether a fluid is driven through the tube or the tube is driven through the fluid, and so the device shown in Figure 3 has been developed for use on aeroplanes to measure the velocity of the ship through the air.

One point must, however, be observed about the flow of fluids—"turbulent flow" develops very frequently, to which the principle of Bernoulli does not apply.

Under a given pressure, water contains a certain amount of air, which, when the pressure is reduced, comes out of the water in bubbles. If water under pressure is run through a tube with a constriction in it, the reduced pressure at the constriction will allow the air to come out, Figure 4, and the water will appear cloudy. This is very frequently observed when water is drawn from a faucet and a constriction is formed where the valve seats itself.

To blow against the broad side of a visiting card and make it come toward you seems paradoxical and yet when this is accomplished under proper conditions it is only obeying that fundamental law of physics about

which we are talking. If the card is held near one end of a spool and air is blown through the spool from the other end, (a), Figure 5, it will be observed that the card pulls up toward the spooler toward the blower and the harder one blows the tighter the card presses against that end of the spool.

A pin stuck through the card, (b), Figure 5, will keep the card from slipping sideways. The air, as it emerges from the end of the spool, will be deflected by the card and flow out radially from the center, A, of the spool as shown in Figure 6. It is evident that the area of cross-section of flow increases from the center outward, making the center of the card, between the card and the spool an area of reduced pressure, compared with that on the opposite side of the

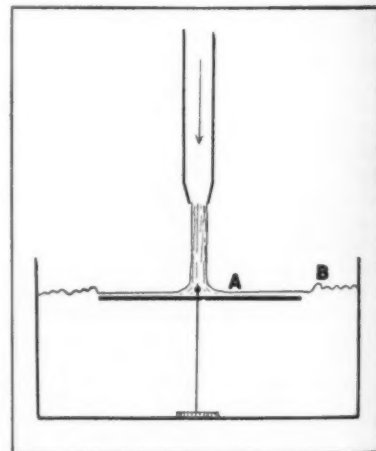


FIGURE 7

The disk paradox experiment performed with a jet of water. A piece of metal is made to float. Use any good sized dish

card. The unbalanced pressure thus produced urges the card against the end of the spool. On a large scale this procedure has been employed for holding blocks of steel in place when drop forgings are being made.

The card paradox may be demonstrated by means of a jet of water and the same spool and disk or card. A more striking way of showing this is to

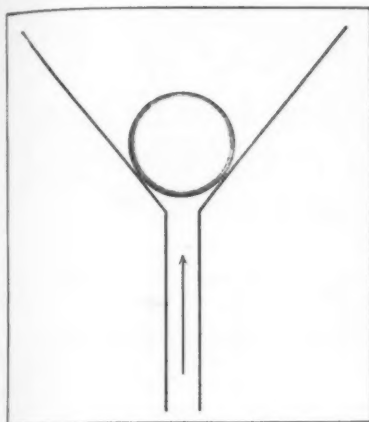


FIGURE 8

The old fashioned fireman's nozzle with a protective conical screen of water worked on this principle, which is explained in the text

place a thin disk of aluminum, five to six inches in diameter, in the bottom of a large sized crystallizing dish, Figure 7. When a well formed stream from a garden hose is directed squarely or normally at the center of the disk, the disk will rise as the dish fills. It seems to be attracted by the stream of water. When the jet of water strikes the disk it spreads out in a thin sheet over its surface and the velocity gradually comes to zero at the edge of the disk where the pressure piles up the water and forms a buoyant force on the under side of the disk, causing it to rise with the surface of the water. Is this the way in which the ancient prophet caused the ax to swim?

A variation of the spool and card experiment is to use a ping-pong ball in a funnel, Figure 8. By blowing or forcing water through from the small end there will be an increased velocity of the air or water at the points of contact between the ball and the funnel. The reduced pressure at these points allows the atmospheric pressure to force the ball into the funnel and hold it there.

Some years ago a well-known manu-

facturing firm in this country used as an advertising device a mechanical clown which carried a wand in each hand. Directly above the outer end of one wand a ping-pong ball was whirling and seemed to be suspended in space without visible means of support. When both arms were stretched out sidewise, the hand holding the wand, above which the ball was spinning, would be swept around in a horizontal circle until one wand came under the other. The hand having the ball in control at first would now return to its original position and the ball would remain in rotation above the other wand. The shrug of the clown's shoulders and jerk of its head indicated that there was a real question involved as to how the ball was held.

A more common demonstration of this phenomenon is the so-called "ball fountain" which is frequently seen in parks and other public resorts. A ball seems to be tumbling and whirling around in a very irregular sort of a fashion on top of a jet of water. Could one have examined the wands held by the clown he would have discovered that there was a jet of air molecules coming out of a little hole in the top of the wand and that the ball was being supported in the same manner by the air-jet as the ball in the fountain.

FIGURE 9 may represent either a jet of air or of water blown at one side of a ball. Since the ball causes the air or water to be deflected at A, in reality it forms a point of constriction to the streamlines of flow, and the pressure at A will be less than at B. This will produce an unbalanced force tending to pull the ball more and more into the stream.

If the ball goes too far and starts to fall out on the other side, the unbalanced force will change its direction by 180 degrees and again the ball will be pulled into the path of the jet. Thus if the jet is directed upward, the force of the impact of the air or water particles will hold the ball up, and if it starts to fall one way or the other, the

unbalanced force will sweep it back into the jet. A friend performs this experiment by blowing into the bowl of his pipe and holding a dry pea on the jet of air which issues from the opening in the stem.

Surface tension plays an important rôle in this phenomenon, and in the other experiments other factors enter, but they will be discussed largely from the standpoint of Bernoulli's theorem.

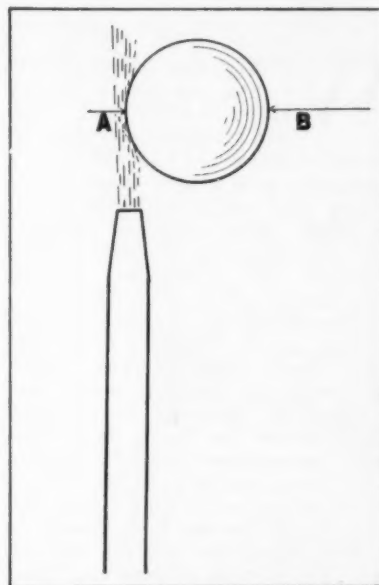


FIGURE 9

The single ball fountain. The ball is held on top of a jet of air or water, remaining there a long time, apparently without cause

Figure 10 shows the same experiment with two light hollow balls made from papier-mache and supported on two strips of thin spring steel. The balls are about four inches in diameter and separated from each other about three fourths of an inch. If one blows between them or directs the current of air from an electric fan at them, there is a tendency for both to pull toward the center of the jet and thus bump into each other. The space between the two balls is a point of constriction and therefore the pressure is less at A than at B, B.

In the next installment of the present article the writer will endeavor to show how Bernoulli's theorem may be applied to a number of commonplace occurrences and observations in life, such as the flight of a boomerang, the rotor ship of Flettner, and the failure of hot-air heating systems under certain unsuspected circumstances.

Have you ever wondered how the sense of sight first came to evolve? Some scientists think it began in tiny primitive ancestral animals, with spots that became increasing sensitive to light. Next month this theory will be explained.

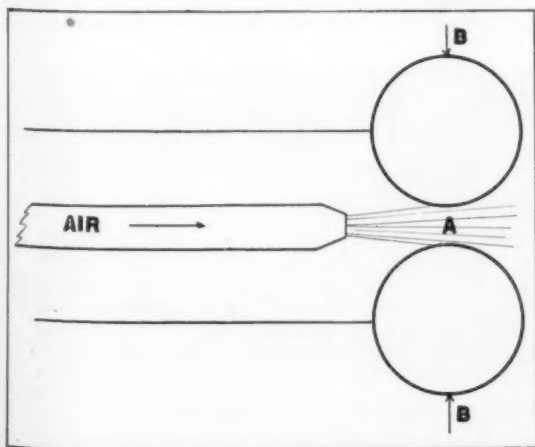


FIGURE 10

The double ball fountain. Due to reduced pressure at A the two balls are pulled together. This, according to Professor Williams, is an example of the working of the theorem of Bernoulli. The balls should be made of some light-weight material, and are about four inches in diameter. The experiment is most easily performed with the aid of an electric fan

Four Sunless Worlds

Jupiter, Saturn, Uranus and Neptune, Once Thought to Be Hot, Are So Deeply Shrouded With Extremely Frigid Clouds That Their Surface Temperatures Remain Unknown

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution of Washington

WHILE the great planets Jupiter and Saturn are still visible in the evening skies, our attention may well be turned to them; and from the writer's standpoint such a topic is natural to choose when one is staying at an observatory where planetary observation has been pursued with especial assiduity and conspicuous success. [Editor's note: Professor Russell's manuscript reaches us this month from the famous Lowell Observatory at Flagstaff, Arizona, where so much research on the planets has been performed.]

There are probably no heavenly bodies except the moon whose telescopic appearance is better known from descriptions, drawings and photographs to the general public than Jupiter and Saturn, and they are both among the favorite objects for amateur star gazing. Yet in spite of more than three centuries of observation since Galileo's days, a great deal remains to be found out about the significance of what we see upon these planets.

Jupiter, even through a very small telescope, shows conspicuous markings—belts running parallel to the planet's equator, and darker than the rest of the surface. They differ from it in color, too, being reddish or brownish, while the regions between them are yellowish-white. A larger instrument shows a multitude of finer details—brighter and darker spots exhibiting many shades of color, which pass across the disk as the planet rotates, returning again to view in a little less than ten hours. It is possible, therefore by making a series of drawings, or better,

a set of photographs to secure a map of Jupiter's whole surface in a single night.

But such a map, however accurately made, would be good for but a few weeks; for the surface details are in constant change. The minor markings may vary from day to day, and even the most prominent features change enormously from year to year. In some cases, for example, the northern hemisphere of the planet was almost free from the dark belts; in others it was free of them. Only a single prominent marking on the planet appears to be enduring—the Great Red Spot. And this, which was once brightly colored enough to deserve its name, has faded out to a pale ghost of its former self, recognizable often mainly by the "hollow" which it forms when it cuts into the side of one of the darker belts and narrows it.

THESE markings are not only changeable, they are in rapid motion. Those on the great bright equatorial belt show a rotation period of nine hours and 50 minutes, while markings in higher latitudes take about five minutes longer for each revolution. It would appear that there is a great current flowing eastward around the equator, and carrying the markings in the zone with it, which gains five minutes in each ten hours, or a whole revolution in about 50 days. Now, it is 275,000 miles around Jupiter, hence the current must flow at the rate of nearly 250 miles per hour. The other belts are moving past one another at slower but still considerable speeds.

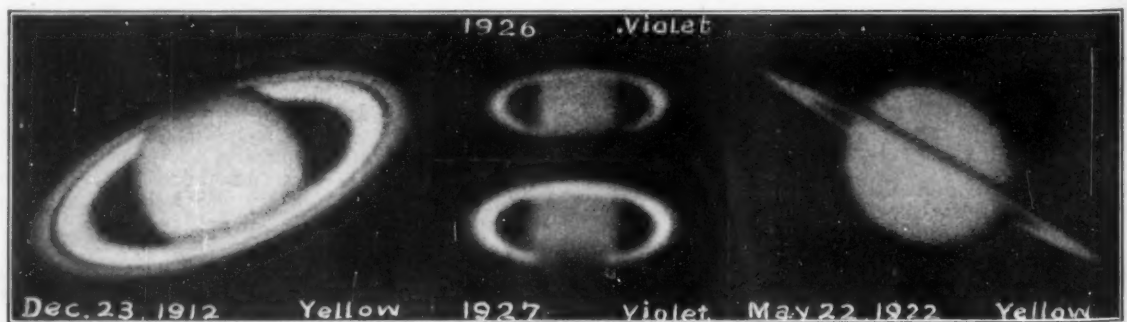
All these facts make it clear that the

markings on Jupiter must be of atmospheric origin—clouds of some sort, and not features of a solid or even liquid surface. To be at all conspicuous on Jupiter, a cloud mass must be two or three thousand miles across. Hence the rapid changes indicate that the planet's surface is extremely turbulent.

Saturn shows somewhat similar features, but its surface is much more quiescent. The belts are less sharply defined and less numerous; and individual markings on them, by watching which the rotation can be followed, are very rare. Indeed, only two dark spots have been observed—in 1876 and in 1903. One was near the equator and gave a rotation period of 10 hours, 16 minutes; the other, 36 degrees from the equator, with a period of 10 hours, 38 minutes. The eastward current at Saturn's equator must therefore flow even faster than the one on Jupiter.

There is still more evidence that all one can see of these great planets is the upper part of their atmospheres. The mean density of both is low—1.34 times that of water in the case of Jupiter, and only 0.71 for Saturn. Moreover, from the relation between the polar flattening and the rate of rotation, it can be proved that in both planets the density is much greater near the center than at the surface. The inner cores may be as dense as rock, or even as iron, but the outer layers must be of very low density and certainly gaseous—probably for thousands of miles below the visible surface.

These facts are familiar enough, but their interpretation is another story. The rapid changes on Jupiter's surface



Photographed at Lowell Observatory, by Dr. E. C. Bipler

SATURN PHOTOGRAPHED AT LOWELL OBSERVATORY, IN LIGHT OF DIFFERENT COLORS

When observed with violet light, the polar regions (note center picture, bottom) and the rings show varying aspects



THREE PHOTOGRAPHS OF JUPITER, MADE BY DR. E. C. SLIPHER, AT THE LOWELL OBSERVATORY

They show the rich surface detail and the difference of aspect when photographed with light of different colors. To those who are unfamiliar with the difficulties of planetary photography, these pictures may seem unduly vague. Yet, as such pictures go, they are remarkable

indicate that there must be a vigorous circulation of the atmosphere, and until recently it was supposed that this must mean that the temperature was high. Indeed, some astronomers suspected that the planet, even at the surface, might be almost red hot. But the radiometric observations of Coblentz and Lampland at Flagstaff, in 1914 and later years, show conclusively that we receive practically no heat from the planet except that carried by the reflected sunlight; and from this it may be calculated that the surface temperature of Jupiter is about minus 140 degrees, Centigrade, or 220 degrees below zero on the more familiar Fahrenheit scale, and that of Saturn still lower. There seems to be no escape from this conclusion, and it follows that the upper atmospheres of these planets must be composed of the "permanent gases," oxygen, argon, neon, or helium; while the clouds cannot be composed of water, or even of ice crystals, but must be formed of some substance like carbon dioxide, which condenses at a much lower temperature.

THE inner portions of the planets are probably much hotter, and we may think of their atmospheres as being hotter deep down than at the surface, and containing layer above layer of clouds of different substances—each at the level where the temperature falls to the condensation point for its appropriate substance. Such a succession of cloudy blankets would provide a very effective barrier against the escape of heat, and prevent the warming of the surface to any serious degree by the external heat.

So far, so good: but what difficultly condensable substances known to us at room temperature as gases are they which give rise to the many kinds of markings which abound on Jupiter's surface and are present in less variety on Saturn too? We know that condensed carbon dioxide is as white as snow, and the same is true of most other solidified gases. Moreover there

is something besides the familiar gases already named in the clear atmosphere which lies above the clouds, and we do not know what this constituent is. Its existence is proved by conspicuous bands in the spectrum, in the orange and red, of the light reflected from Jupiter. These bands are stronger in that from Saturn, and as Slipher has shown, are stronger still in Uranus and extraordinarily strong in Neptune. Up to the present time these absorption bands have not been matched in the laboratory, and we have no idea to what they may be due. The atmospheric temperature is so low, even on Jupiter, that the field of possibility would seem to be very limited and our lack of success surprising. Two suggestions may, however, be made in explanation.

First, it may be that these bands are absorbed with perceptible strength only when light has traversed a great thickness of the gas. For example, the strong bands of oxygen at the red end of the solar spectrum, which originate by absorption at the earth's atmosphere, can be observed in the laboratory only when transmitting light through many yards of air. And even then they are excessively faint. It requires a mile or more of air to bring them out at all strongly. But except for the gases which are present in our atmosphere, the experiment of transmitting light through a mile or two of gas has never been tried.

A SECOND possibility is that the bands may be due to some gaseous compound which is stable only at very low temperatures and is decomposed entirely at the ordinary temperature of our laboratories. This suggestion, first made by Marzel, is supported by the steady increase of the bands in passing from Jupiter to Neptune, which in all probability is colder at the surface than any other planet. Here, again, experimental evidence in the laboratory is almost lacking—except that it is known that some of the oxides of nitrogen can be protected

from decomposition only by keeping them very cold. It may be that both suggestions are true, and that a great thickness of very cold gas is necessary to produce the bands.

Some similar explanation might be invoked to account for the remarkable variety of colors among the surface details of Jupiter and Saturn, which immensely exceed the range of colors exhibited by the most vivid terrestrial clouds.

All this is frankly speculative, and the reader should be on his guard against supposing that the writer means to state that these possible explanations are the correct ones. This brief discussion of them may, however, be of interest, both as indicating how many problems, still unsolved, familiar bodies like the planets present to the astronomer, and what strange apparatus he may some day be tempted to devise in searching for a solution of these problems.

ONE would hardly think, even in imagination, of astronomers desiring to build a long tube, jacketed from end to end with liquid air, to fill the tube with all the various gases with which the chemist could supply them, and then to pass light through it and see what sort of light, if any, were absorbed. But such a strange and costly equipment, and perhaps still queerer devices in which all sorts of gases were condensed into clouds to see what colors they exhibited, may one day give the clue to the nature of the visible markings on Jupiter and Saturn. It is to be hoped, however, that some simpler line of attack may prove successful, for the expensive one dreamed of here is not likely to be attempted tomorrow.

Through the courtesy of the writer's friends at Lowell Observatory it has been possible to illustrate this account with some of their beautiful photographs of Jupiter and Saturn which show more than the inexperienced observer can usually see directly, even with a good-sized telescope.

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Field

By MORRIS FISHBEIN, M. D.

Editor of the Journal of the American Medical Association and of Hygeia

Wilshire's I-ON-A-CO

CALIFORNIA again has the privilege of providing a form of quackery beyond even the dreams of the late, but not too late, Albert Abrams. Gaylord Wilshire, whose career in socialism is not a secret, is the exploiter of the device called by him "I-On-A-Co," but aptly renamed by Dr. Arthur J. Cramp of the Bureau of Investigation of the American Medical Association as the "magic horse-collar." According to the advertising of this device, it will cure cancer, Bright's disease and paralysis, restore patients with pernicious anemia to health, relieve varicose veins, make the dumb talk and the deaf hear, and even cure a dog of St. Vitus' dance.

The Public Health League of the State of Washington and the Better Business Bureau of Seattle cooperated in an investigation. The investigation committee included a technician from a firm manufacturing X-ray apparatus, a business man, the secretary of the State Pharmacy Association, the secretary of the Public Health League and two physicians, also the dean of the college of engineering of the state university, the commissioner of health of Seattle, and the construction engineer from the city light department of Seattle.

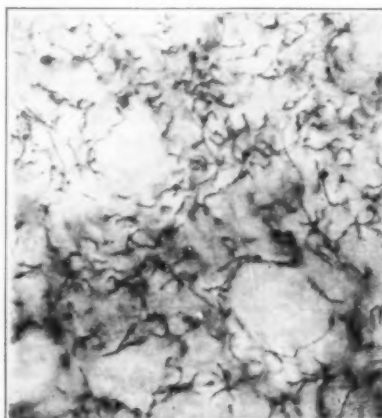
The report of this committee was, in effect, as follows:

"The I-On-A-Co is simply a coil of insulated wire (about six and one-half pounds of 22 gage, worth about \$3.50) about 18 inches in diameter, with a plug that permits the coil to be attached to an electric light socket. There is a smaller coil that plays no part in the alleged curative use of the I-On-A-Co but plays an all-important part in the magical features of the scheme by impressing the purchaser with the marvelous potentialities of the larger coil. The small coil is also of insulated wire (about one pound of 18 gage, worth about 60 cents), with its two free ends attached to a miniature light socket containing a small flashlight globe. When the larger coil is plugged into an electric light socket where there is an alternating current (the kind of current that is found in the great majority of city lighting systems), there is, of course, generated within the large coil a weak fluctuating magnetic field. This will cause the

flashlight globe in the small coil to light up when the small coil is brought in close proximity to the large coil. This phenomenon, while elementary to a degree to those who know anything about electricity and magnetism, furnishes for the uninitiated that element of mystery which is so necessary to the successful exploitation of any alleged cure for human ailments."

As pointed out by *Hygeia*, the health magazine, published by the American Medical Association:

"The I-On-A-Co is used by placing this magnetic horse-collar over



THE GERM OF SYPHILIS

A specimen of tissue stained to reveal the spirochete which causes the disease

the neck, around the waist, or around the legs of the person who thinks he is going to be helped by a piece of buncombe of this sort. It sells for \$58.50 cash or 65 dollars on time. The cost of the materials for making an I-On-A-Co should not exceed five dollars. As a cure for any physical ailment it is not worth five cents."

Detecting the Organism of Syphilis

WHEN Noguchi, the famous Japanese investigator, showed that the organism that caused syphilis was present in the brains of persons suffering with "softening of the brain" and general paralysis, he made one of the most notable advances in modern medical science. Later investigators have attempted to develop methods that would reveal the presence of the germs in specimens of the tissue that were stained and put under the micr-

scope. Recently Dr. Robert R. Dieterle of the State Psychiatric Hospital in Michigan described a method for staining this germ, which makes it visible to any observer. A specimen of brain tissue stained to reveal the germ of syphilis is here shown. By this method the spirochete which causes the disease is shown in dark brown or black in contrast with the gray color of the tissue in which it appears.

Heat Stroke

DRS. E. S. WAKEFIELD and W. W. Hall of the United States Navy Medical Department have just made public the results of a special study of heat stroke to determine the type of change that takes place which results in permanent injury. Heat stroke is one of the oldest known diseases, since descriptions of it occur in biblical legend. It has always been common on board ship because of the peculiar conditions existing below deck. The deaths of 68 persons from heat stroke during a brief hot spell in New York City is significant of the importance of this subject. There is an historical record of a hot period in Peking in July, 1743, in which 11,000 persons are said to have died.

All sorts of methods of treatment have been devised, of which, however, few are specific. More recently cold applications have been used, since the temperature tends to rise steadily. The patient is removed immediately from the heat, tight clothing is loosened and removed and the patient is given plenty of fresh air. However, following a return to consciousness there may be permanent disturbances of speech, difficulty in swallowing, headaches, dizziness, loss of appetite and even mental disturbances of great seriousness.

The observations made in the United States Navy Department indicated that heat injuries are greater in those born and reared in the northern sections of the country than in those coming from the south. Apparently it is possible to become habituated to a certain extent to heat exposure as well as to other physical conditions. The experiments also indicated that heat production in the living human being is brought about by oxidative process principally in the muscles.

In the cases studied, the animals

were submitted to considerable rise of temperature in an atmosphere with high humidity. Following heat stroke, samples of blood were obtained and studied by modern blood chemistry methods. Apparently the kidneys were greatly injured, the blood sugar increased in some cases but decreased in others, the alkali reserve was decreased greatly in every instance and the lactic acid content of the blood reached extremely high levels. The most important changes in the body are, therefore, those commonly characterized under the word "acidosis." High accumulation of acid in the body produces all of the symptoms that have been recorded. This naturally indicates specific methods of treatment which may be found to be of great service.

Discoveries by Young Men

A RECENT investigation of discoveries made in medical science brought to light the fact that many of the most important ones were the work of young men. For example, diphtheria antitoxin was first used by Von Behring when he was 31 years old. Banting discovered insulin in 1923, when he was 31 years old. Madame Curie did her work on radium in 1879 when she was 32 years old. Darwin did his work on the origin of species at 29, and Wallace contributed his share at 36. Paul Ehrlich, discoverer of salvarsan, published his earliest investigations at the age of 23. The organism of gonorrhea was discovered by Neisser when he was 24, and the organism of syphilis by Schaudinn when 34 years old.

Joy Beans

IN Cairo, Illinois, there was manufactured a preparation known as "Joy Beans." As might be guessed from the title, these pills were advertised with all of the old claims of vim, vigor and vitality in periodicals appealing principally to men. Much was said in the advertising about weak and worn out glands, about pep, fighting blood and the fountain of youth. Anybody could buy the joy beans, and they were even sold to an eighty-one year old man with the

claim that they would provide him with all the attractiveness and capability of youth. An investigation of the contents of the preparation indicated it to be a mixture of half dozen or more substances supposed to be of importance in stimulating the human body but proven quite incapable of accomplishing the results claimed for them by the manufacturer. The Government recently issued a fraud order against the promoter and barred him from the use of the mails. Of course, this sort of thing can still be sold in any drug store that cares to handle it.

More Facts About Light

THE pioneer in the application of light in the treatment of disease was Finsen of the Copenhagen, Denmark, Institute. Sunlight has been most widely popularized by Rollier in Switzerland, and the ultra-violet rays largely popularized by Sir Henry Gauvain of England. Much of the most important work on the relationship of light to rickets has been accomplished by Hess and Steenbock in this country. The story is again a demonstration of the international character of advance in a branch of medical science.

Recently Dr. Edgar Mayer of the Trudeau Sanatorium group in Saranac Lake, New York, considered the fundamentals of the clinical aspects of the use of light in the treatment of disease, especially in relationship to tuberculosis. The action of the light, he points out, is largely through its effects on the skin and nerves and the blood vessels. Cholesterol, a substance found in comparatively large quantities in the skin, is activated quickly by ultra-violet rays. The substance itself may be taken from the body and made to develop power against the disease of rickets by irradiating it with ultra-violet rays. Apparently the substance that is involved is ergosterol, or an allied substance that is found in ordinary cholesterol as an impurity. The mechanisms are not definitely understood, but the effects are scientifically determinable. For example, a mother who is nursing a child may be exposed



ULTRA-VIOLET TREATMENT

A patient is shown exposed to the rays emanating from a special quartz lamp

to the ultra-violet rays whereupon the substances that have the power to prevent rickets will appear in the mother's milk.

Many of the persons using light treatment believe that the only good light for the purpose is actual sunlight. It possesses the advantage of the psychic reaction which makes the patient willing to submit to prolonged periods of exposure. On the other hand, the artificial light, including either the quartz mercury-vapor arc light or the carbon arc-light can be used in any sort of weather, is easily controlled and may be measured as to actual dosage. While the dosage cannot be fixed in the same way as the dosage of a drug, it can be measured by the extent to which it produces redness or burning of the skin. An overdosage may produce injury, since apparently there are definite changes in the resistance to infection, in the setting up of serious reactions and similar processes that are of great importance.

The most visible response to the use of sunlight has been in tuberculosis of bones and joints, of the intestines and of the glands. Less visible results have been obtained in tuberculosis of the lungs, of the eyes and of the throat. While it is not urged to be unduly optimistic about this form of treatment, according to Dr. Mayer, it is important to recognize that it is one of the most important adjuvants that is available at the present time for the treatment of tuberculosis.



SUNLIGHT TREATMENT

A group of children at the outdoor school at Onondaga County Sanatorium, Syracuse, New York. They are kept out-of-doors as much as possible and the sunlight is allowed to play on their almost nude bodies. This photograph is by courtesy of Drs.

Brayton and Walsh

Cold Light

How Do Fireflies Emit Light Without Emitting Heat?

By DR. W. W. COBLENTZ

Physicist, United States Bureau of Standards

IT seems born into man to be always inquiring into the why and the wherefore of things. And certainly when it comes to the question of the artificial production of light there is a very good reason for being inquisitive.

In the days of our forefathers, the most efficient source of light was the tallow candle in which considerably less than 1 percent of the total energy radiation was emitted as light. The remaining 99 plus percent was radiated in the form of invisible "heat rays."

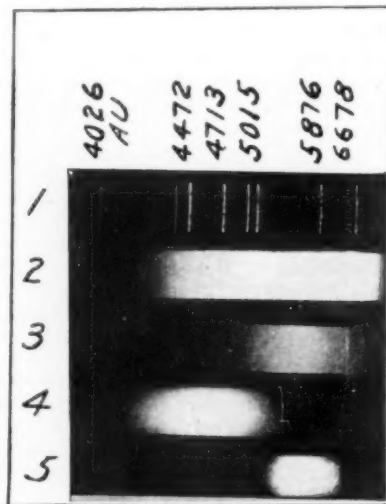
Even at the present day in spite of all our vaunted progress in many things, the best we can boast of in our light sources is a radiant luminous efficiency of only 5 to 10 percent. That is to say, for every dollar's worth of electrical power that we use, we obtain only about five cents worth of what we call "light." All the rest is emitted in the form of invisible ultra-violet, and especially infra-red rays, which have a great heating value. If a firefly or other luminous animal were so extravagant it would have to be provided with a special cooling system, else its body would be dried up.

"TURN to the ant and learn wisdom" may very appropriately be paraphrased to include animals and plants emitting light. For they have the secret method of emitting "cold light" consisting of a narrow band of radiant energy of short wavelengths which happen to fall into that part of the spectrum to which our eyes are sensitive. But why do they emit light that lies in this particular spectral region and not in the deep ultra-violet or infra-red? And most important of all, how do they do it?

One way for a physicist to attack the problem is to study the spectral range in which the light is emitted; also the shape of the spectral energy curve as compared with that of some well-known source. But the intensity of the light is so weak that it is impossible to measure it directly by means

graphing the spectrum of the light emitted. The light of the firefly and the luminous crustacean (Cypridina) which lives in the ocean, is very intense and hence it requires only 30 minutes to an hour to obtain a good spectrogram. On the other hand the light emitted by the luminous wood, "fox fire," which is caused by the mycelium or vegetative system of the fungus *Agaricus melleus*, is extremely weak. It was therefore necessary to expose the photographic plate for 50 to 70 hours in order to obtain a good spectrogram of the luminous wood.

The procedure employed consisted in placing the luminous wood before the spectrometer slit and replacing it with fresh material every three hours, night and day, for three days. In the meantime the room was kept dark and the material was kept covered with a dark cloth to prevent stray light from entering the spectrometer slit.



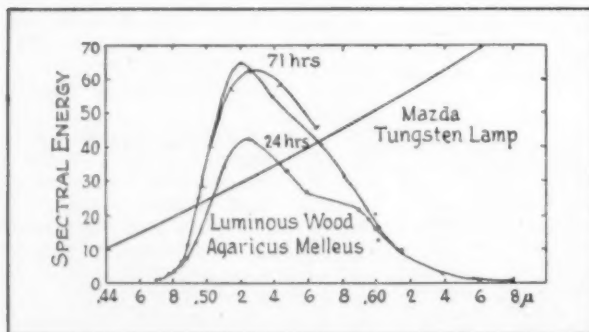
SPECTROGRAMS

FIGURE 1—Top, helium tube; (2) carbon filament; (3) luminous wood; (4) the crustacean *Cypridina*; (5) fire fly

of a radiometric instrument such as, for example, a thermopile. Recourse must therefore be had to the photographic plate which is cumulative in its action and hence can be employed to advantage in this type of work.

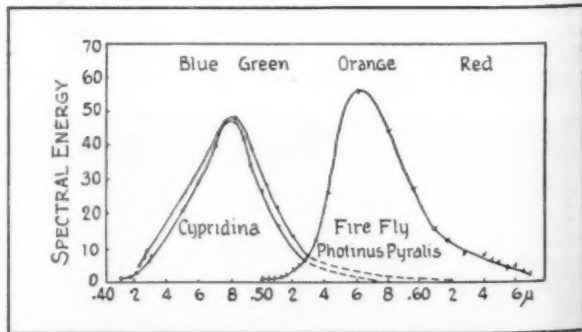
The experimental procedure therefore consisted in holding the firefly with its luminous segments over the entrance slit of the spectrograph, and photo-

graphing the spectrum of the light emitted. The spectrum of the firefly and the luminous crustacean (*Cypridina*) which lives in the ocean, is very intense and hence it requires only 30 minutes to an hour to obtain a good spectrogram. On the other hand the light emitted by the luminous wood, "fox fire," which is caused by the mycelium or vegetative system of the fungus *Agaricus melleus*, is extremely weak. It was therefore necessary to expose the photographic plate for 50 to 70 hours in order to obtain a good spectrogram of the luminous wood.



SPECTRAL ENERGY DISTRIBUTION OF FUNGUS

FIGURE 2—This shows the intensity of the light emitted in various colors. The peak is at 0.52 microns wavelength, a micron being about one 25,000ths of an inch, and therefore it falls in the green



SPECTRAL ENERGY DISTRIBUTION OF OTHER ANIMALS

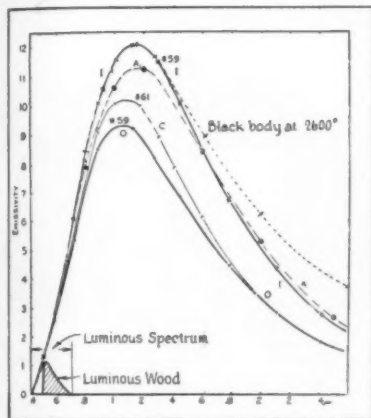
FIGURE 3—Explained in the text. The visible spectrum extends from 0.39 microns wavelength (violet light) to 0.76 microns (red light). A micron equals 10,000 Angstrom units (AU, Figure 1, top)

Redrawn from Scientific Paper Number 538, United States Bureau of Standards

Figures 2 and 3, at bottom of page 316.

The spectral energy distribution of the luminescent fungus *Agaricus melleus* (Figure 2) is unsymmetrical, extending from 0.43 to 0.67 microns with an intense emission maximum at 0.52 microns, and probably a weak maximum at 0.58 microns. As shown in Figure 4 the spectral energy curve is entirely lacking in infra-red, as compared with one of our most useful sources of light.

The spectral energy distribution of the luminescent crustacean, Cypridina, (Figure 3) is symmetrical, extending



A COMPARISON

FIGURE 4—When man produces light with tungsten filaments (upper curves) most of the energy is expended in heat or infra-red waves (beyond 0.76 microns). But note that none whatever of its energy is thus wasted in making heat by luminous wood

from 0.41 to 0.62 microns, with a maximum at 0.48 microns in the blue-green. The spectral energy curve of the light emitted by the firefly, *Photinus pyralis*, (Figure 3) is unsymmetrical, extending from 0.50 to 0.68 microns, with a maximum in the region of 0.565 microns, verifying previous observations.

The light emission of decaying wood presents some interesting problems. At A in Figure 5 is shown a piece of wood, the bright edge of which emits light, caused by the mycelium of the fungus, *Agaricus melleus*. At B is shown the brown tubular mycelium growing out of the wood. The tip B where the active metabolism [Chemical processes taking place in the living cell—Editor] is in progress, is greenish yellow in color, and it emits light. C and D are photographs of a piece of wood made by the light emitted by the fungus, by placing the wood in contact with the photographic plate. The central dark region shows the path of the steel chisel used in splitting the wood.

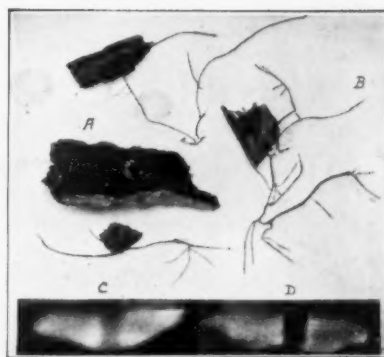
This picture shows, as found by others, that the most intense light emission is obtained from the broken and torn mycelium on the surfaces that had not been touched in splitting the wood. An interesting observation is that the brightest glow occurs on that

portion of the surface close to the part compressed by the chisel. Whether this is owing to the greater number of mycelia compressed into this space or to stimulation remains undetermined.

For more than three centuries it has been known that this kind of light production requires oxygen and that it is not a heat-producing combustion of the wood. The mycelium lives for years and the light of a luminous form of fungus seems to continue while active metabolism is in progress. One sample has been kept since September, 1925, and it is still active.

Although the extent of the spectrum of a number of luminous organisms has been photographed, but little information is at hand concerning the distribution of the energy in the spectrum of the light emitted. The present investigation being conducted at the United States Bureau of Standards is a small contribution to this subject. Just how it will fit in with other work cannot be foretold. Thus it was with my research 15 years ago when it was shown that the light emitted by various species of fireflies differs greatly in spectral energy distribution.

IN an unforeseen and unexpected manner, this information proved useful in showing which is the light-producing and which is the light-giving substance (luciferin and luciferase) that is obtainable from the firefly. By dialysis, the process of separating the soluble crystalloid substances in a mixture from the colloidal ones, Prof. E. Newton Harvey of Princeton, was able to show that the material obtained from the luminous organs of fireflies can be separated into two constituents which are essential in light production. These two constituents are (1) a heat-resistant, dialyzable substance called luciferin which takes up oxygen and oxidizes with light production in the presence of (2) a heat-sensitive, non-dialyzable, enzyme-like [Enzymes are catalyzers or promoters of chemical re-

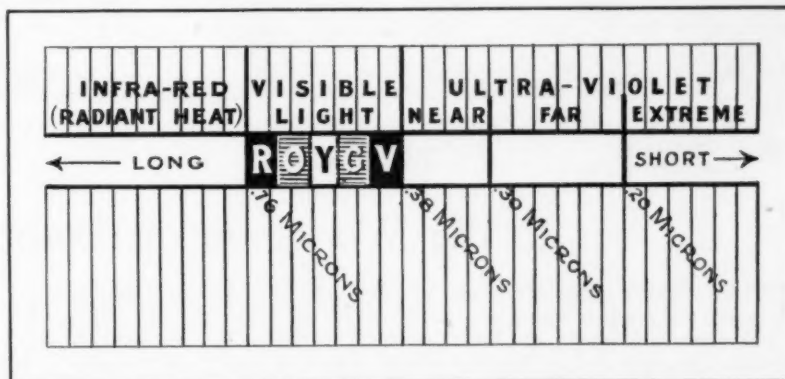


TAKES ITS OWN PHOTOGRAPH

FIGURE 5—above, Luminous wood; below, it photographs itself, as explained in the text

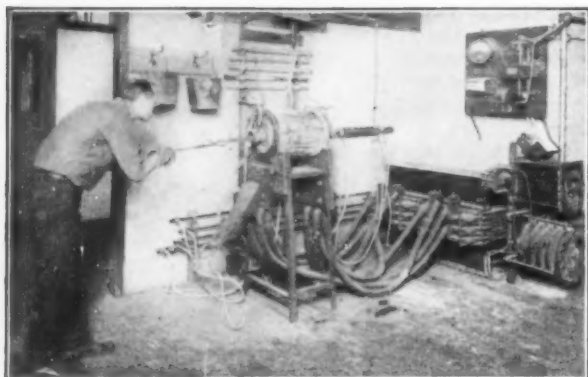
actions in living cells—Editor] substance called luciferase. The latter appears to be an organic catalyzer which accelerates the oxidation of the luciferin, the intensity of the luminescence being dependent upon the reaction velocity or rate of oxidation. By mixing the luciferin of one species of firefly with the luciferase of another species, Professor Harvey was able to show that the light produced is characteristic of the animal supplying the luciferase.

In conclusion as in the beginning of this paper we ask the question "How do they do it?" It is not a question of selective transmission through the outer skin or coat, whether animal or vegetable matter. As far as we can determine, they produce these rays in the visible spectrum, and there only. On the other hand, when we human beings want visible rays we must produce practically the whole spectrum—ultra-violet, visible, infra-red. The overall efficiency of bio-luminescence is probably not much higher than that of man-made light, as shown by Harvey. Nevertheless, to be able to control the emission of radiation to the particular part of the spectrum desired, especially to visible spectrum rays, is a problem that remains to be solved.



THE FEW RADIATIONS OUR EYES PERCEIVE

This is a small part of the great electromagnetic spectrum which extends all the way from wireless waves to cosmic rays. It includes only the comparatively narrow band of wavelengths which is perceptible to our sense of sight, with part of its infra-red neighbor on the left and ultra-violet neighbor on the right. The letters are for the colors of the visible spectrum. For convenience, the physicist sub-divides arbitrarily the ultra-violet into near, far and extreme



◀ HOT!

The hottest part of the laboratory is in the furnace illustrated, where the most refractory of all metals can be melted by means of electricity

COLD! ➤

In contrast with the furnace, is the machinery for the manufacture of liquid air. In the illustration, a man is pouring some of the liquid



Dr. W. R. WHITNEY

He is the director of the laboratories in which these photographs were taken



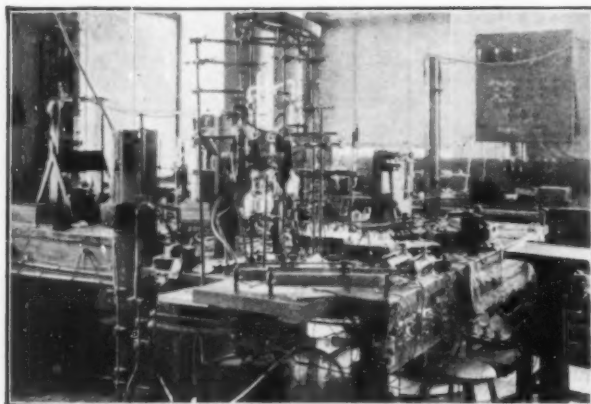
Dr. IRVING LANGMUIR

An assistant laboratory director, he has contributed much of value to science



Dr. W. D. COOLIDGE

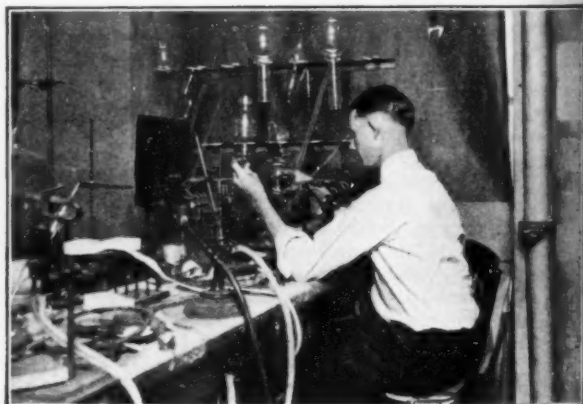
Also an assistant director, his most famous work has been with cathode rays



All photographs courtesy General Electric Company

Dr. LANGMUIR'S EXPERIMENTAL TABLE

Many valuable contributions to science, including the well-known ductile welding process, have been worked out at this bench



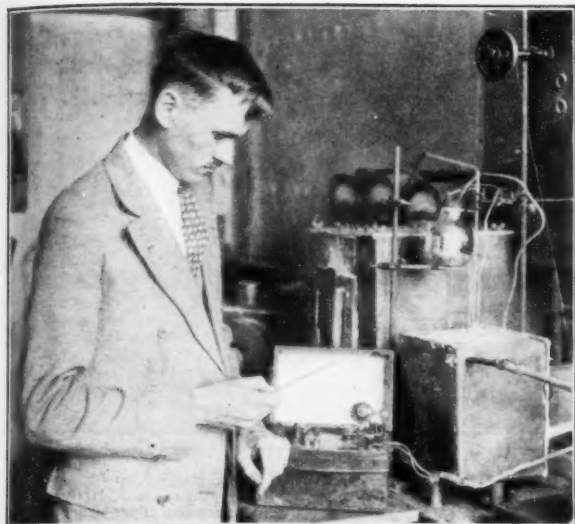
THE GLASS-BLOWING LABORATORY

Many pieces of intricate glass apparatus are required by the laboratories. A corps of expert glass-blowers furnish them all

In the Workshop of the Scientists

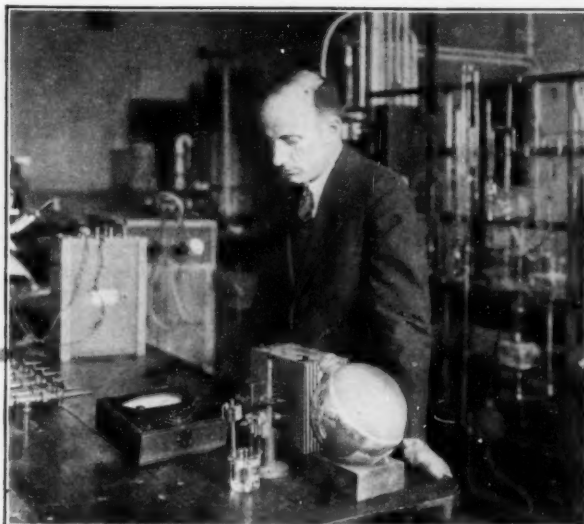
THAT scientific experimental and research work is on a sound and result-bringing basis is proved by the series of photographs taken in the laboratories of the General Electric Company and reproduced above. Here we also find portraits of three of the men who are daily applying their vast knowledge of the various branches of science to the solution of problems which will eventually accrue to the benefit of mankind in some form. That this form may be far different from that which was first in mind when the experimental work was started has often been the fact,

but nevertheless, the results are practically always well worth while. In these laboratories have been developed such commercial processes as the electric arc for welding, the manufacture of ductile tungsten, the atomic-hydrogen welding method, and the construction of X-ray tubes of all sizes and powers. Coincident with these commercial developments have been the work on such devices as the well-known Coolidge cathode-ray tube. First a scientific curiosity, the rays generated by these tubes are finding uses now which were heretofore unthought of. Then there



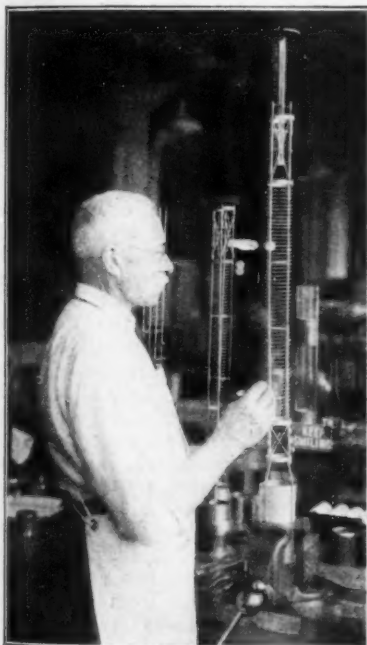
A SINGLE METAL CRYSTAL ▲

The scientist holds a single crystal of zinc produced in the furnace shown above



▲ MEASURING DAYLIGHT

The photoelectric cell is so connected that light intensity is indicated directly



GIANT TUBE

The "works" of a 100-kilowatt radio transmitting tube. The filament, made of tungsten wire, is eight feet long and about as large in diameter as the lead of a pencil



PHOTOELECTRIC CELLS

The tiny cell is used in talking "movies"—large one in radio picture transmission

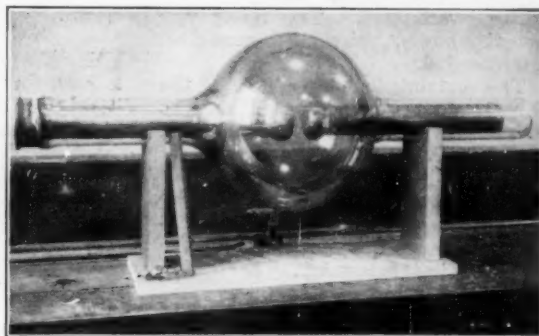


MORE SINGLE CRYSTALS

Top: Single crystals of copper. Lower: Crystals of zinc, lead and cadmium

CATHODE-RAY TUBE

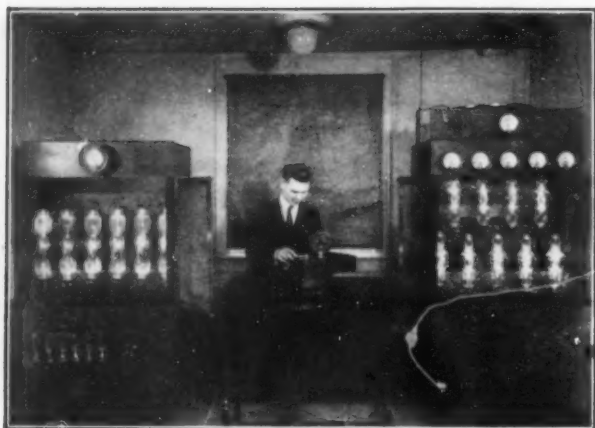
The largest cathode-ray tube that has as yet been constructed. The bulb is 20 inches in diameter. For comparison, a 15-inch rule is shown in the photograph, standing upright near the left support. The smallest X-ray tube rests at the base of the support. This type of tube is extensively employed for dental work. It works at low power



Where Science Problems Are Solved

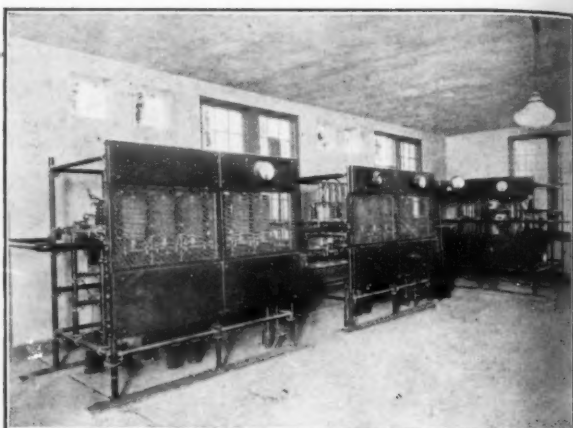
is the development of the radio vacuum tube, ranging from the tiny tubes used in dry-cell operated radio receiving sets to the giant water-cooled tubes employed for transmitting and capable of handling power up to 100 kilowatts. Each and every type of tube has its own particular purpose, and therefore presents different problems to the research scientist. The solving of these problems often leads to widely diversified fields and require the building of special apparatus. To supply these needs, special shops for the construction of apparatus of unusual design have

been established and fully equipped. For example, note the glass-blowing shop illustrated above. Here the enclosures for all kinds of vacuum tubes and other apparatus are built to order. Special furnaces such as the one illustrated on the opposite page are employed for various purposes, such as the study of metals and their alloys. Many substances which find wide application in industry are the result of experimental work of this type. Who can say what will be the next startling invention which will be brought forth from these workshops of science?



AS IT WAS

The first transmitter used at station WJZ when it was located in Newark, New Jersey, in 1921. The engineer is checking the wave with a wavemeter. Note the phonograph on which the meter rests



AS IT IS

Part of station WJZ, now located at Bound Brook, New Jersey. The oscillator and modulator tubes shown are part of the 50-kilowatt installation now being used for transmission by that superpower station

A Radio Pioneer Steps Onward

Should Listeners Welcome or Fear KDKA's New Transmission System?

By ORRIN E. DUNLAP, JR.

THE old adage that "it is darkest just before daylight" has been applied often in the realm of radio. The ether over the United States was so congested when the Federal Radio Commission came into power that it found broadcasting in a state termed "chaos." There were 735 transmitters pumping entertainment into space. Many of the waves overlapped. The result was squeals, howls, voices and music all intermingled.

The commissioners studied the situation and soon compelled stations to share waves and divide time on the air. They drew charts to prove visually that there is not enough space between 200 and 550 meters for more than 400 transmitters to operate simultaneously in this country. The separation between waves was ordered to be 50 kilocycles in New York and Chicago, while in less congested zones the spacing was left at 10 and 20 kilocycles. Three hundred applications were on file in Washington waiting for permits to begin broadcasting or to build a station. The situation looked hopeless. It was a "blue Monday" for many stations when they were ordered to share their waves. Some protested.

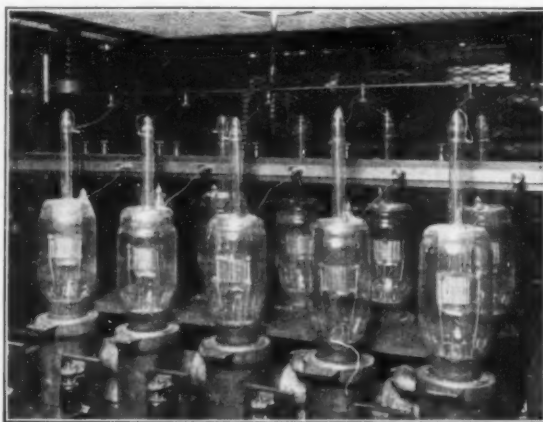
Two broadcasters in Iowa asked through their micro-

phones that a million listeners write to the Radio Commission requesting that the stations retain their two channels. The first mail the next morning brought 3326 letters, and before these were opened the second mail came with another flood, all from listeners of the two Iowa stations. The number of letters presented a stenographic problem for the limited staff of the commission.

THEN came the dawn with a new light in the announcement from Pittsburgh that the engineers of the Westinghouse Electric and Manufac-

turing Company had devised a new system of "broadcast transmission of such far-reaching effect that apparently closed fields of radio progress are now opening to future explorations." In the new system, the frequency band has been cut to one half kilocycle, which means that broadcasters can operate within one half kilocycle of each other. Greater significance was attached to the announcement by the declaration that KDKA, the pioneer broadcaster, was using the new system with success. It was KDKA that began broadcasting for the first time on November 2, 1920. Hundreds followed in the wake of the first waves from Pittsburgh. Today others are keeping a watchful eye on KDKA, wondering if the pioneer again is blazing a trail into a field of radical improvement. Some say "yes" and some say "no."

Engineers explain that there are 950 kilocycles in the broadcast band between 200 and 545 meters. Therefore, it is estimated that with a system which enables one half kilocycle separation, approximately 1900 broadcasters can operate simultaneously without sharing waves or splitting time. Furthermore, all stations could have exclusive channels should such a system be adopted on a national scale. It has been reported by



WATER-COOLED TUBES

A bank of vacuum tubes used for transmitting over the transatlantic "talk-bridge" which uses the amplitude system of modulation with the carrier and one side-band suppressed



C. W. HORN

Mr. Horn is director of operations for the company which owns station KDKA. He is experimenting with frequency modulation

listeners during the weeks in which the system has been in operation at KDKA that the waves tune very sharply at nearby points, even while the transmitter radiates as much as 50,000 watts. Auditors in Michigan, New York and New England have reported that the signal strength is stronger than when the ordinary method of transmission is employed.

All modulator tubes are said to have been eliminated at the Pittsburgh station. This means a saving of twelve ten - kilowatt water - cooled tubes. These tubes cost about 175 dollars each and have short lives. In the usual methods of broadcasting, half the total energy is estimated to be absorbed and dissipated as heat, amounting to 80,000-watts, or approximately the power required to light 2000 ordinary incandescent lamps. This energy is now saved, and can be made available to increase the power of the transmitter if desired, according to the Westinghouse announcement.

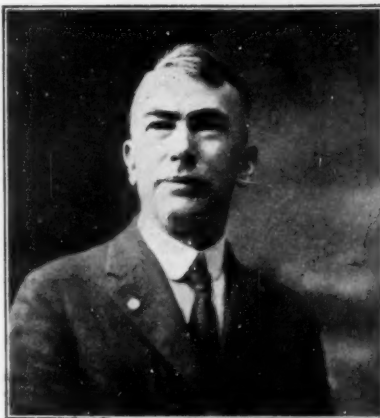
"So radical is the departure from present methods of broadcasting that the engineers hesitate to forecast the great improvements in transmission that apparently will result from the general application of the system," said the company's statement. "It is important enough for the present that these new fields of radio endeavor have been opened wide for further development."

The engineers define the system as "frequency modulation." They say that it is a revolutionary departure in nearly all respects from the generally used method of

"power modulation." It is explained that a ten-kilocycle separation between stations will be required with the present type of radio receivers, which cannot tune sharp enough to take full advantage of one half kilocycle separation which the frequency modulation is said to afford.

"THE system has unprecedented operating efficiency," said the announcement. "It eliminates three quarters of the transmitting tubes at KDKA, permits the broadcasting of a wave many times sharper than heretofore possible, and provides the range and quality of transmission with less than half the usually required power input. It is regarded as extremely important in offering a practical solution to many problems of transmission, including the possibility of great reduction in station interference. It opens up a field in which engineers foresee an opportunity to overcome static and local interference."

Listeners in the vicinity of western Pennsylvania are said to have noted an immediate effect in the lifting of the blanketing effect that usually surrounds high-power transmitters. The improvement is credited to the sharpness of the radiated wave. The engineers explain that by this system,



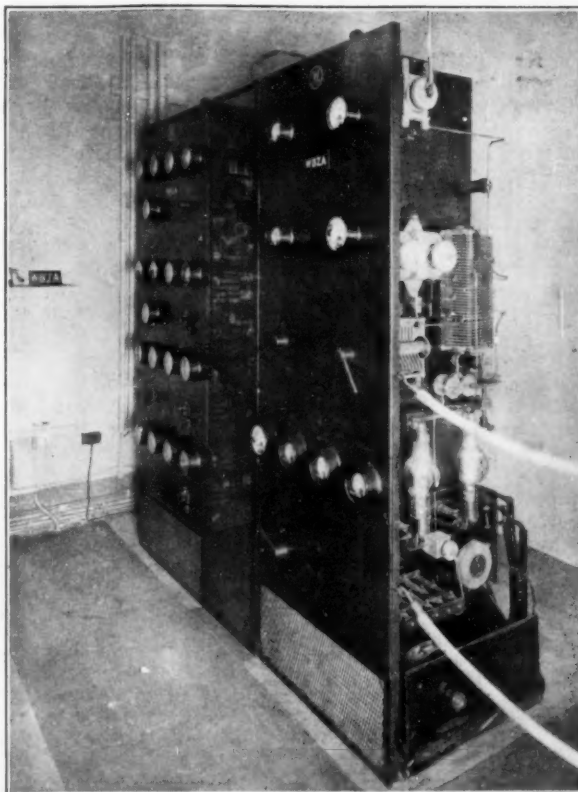
FRANK CONRAD

Mr. Conrad has been with KDKA since it first went on the air. Like Mr. Horn, he is experimenting with frequency modulation

instead of varying the amplitude or strength of signal, as is the present practice, KDKA is maintaining an even, constant strength of signal while the frequency of transmission varies by a very small amount—usually not more than 500 to 800 cycles.

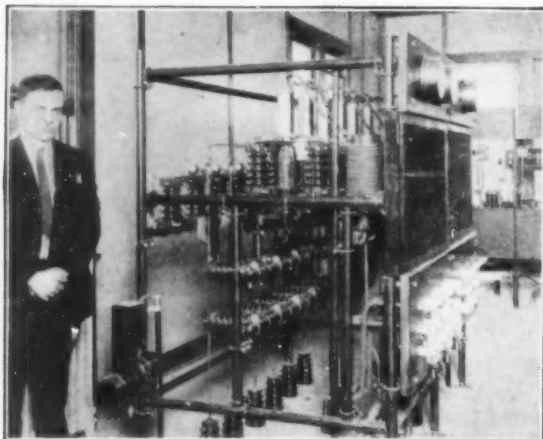
The heralding of a new system of transmission came as somewhat of a shock to the radio industry. There is always a certain element in the radio field, as in all youthful undertakings, standing ready to point to the "revolutionary developments," and in many cases improvements have been labeled as "revolutionary." Manufacturers of receiving sets became very much alarmed, because they are well aware that the public numbering millions has fought shy of radio, always waiting for the "revolutionary developments." When the KDKA announcement was made, there were some who predicted the crumbling of the current broadcasting structure and the discarding of receiving sets for new and more efficient models. Such is not likely to happen. A new transmission system could not be put into effect "over night," unless it allowed reception by existing receivers, otherwise the audience of the broadcasting stations would dwindle to small numbers, because 6,000,000 radio set owners would not rush to buy new sets.

Broadcasting stations today use what is known as the power or amplitude modulation system, while the KDKA development is based upon frequency modulation. Neither system is new. In



MODERN EQUIPMENT

The new transmitter recently installed at station WBZA, Boston, Massachusetts. Compare this photograph with the one of the first installation at station WJZ, reproduced on page 320, and with the illustration of the original WGR, found on page 322



SHORT WAVES

This is one of the experimental transmitters that has been installed at station KDKA for the purpose of establishing contact with foreign lands on the shorter wavelengths. Work of this kind has been highly successful, particularly that done by the amateurs, who, with very low powers, have found it possible to cover enormous distances. Many of them have communicated with foreign stations, using different short-wave bands

fact, frequency modulation was utilized by Professor Reginald Fessenden a score of years ago and by many experimenters since that time. It is safe to say that a radically new transmitting system has not been discovered, but it is entirely possible that the experts at KDKA have made great improvements in the old method. Since the initial announcement, an air of mystery has blanketed the developments at KDKA. Nevertheless, a careful analysis of the situation makes it apparent that there is no ground for fear that the purchaser of a radio receiver this fall is doomed to disappointment because of a new system of broadcasting. Who would pay for scraping the 600-odd transmitters now in operation and the 6,000,000 receiving sets? How many radio set owners would spend a hundred dollars or more for a new set if their present receivers were made obsolete? The days of radical changes in radio are over. Improvements will come for sure but all big changes will be gradually slipped into the system so as not to disturb it or annoy the vast audience.

All fear of a revolutionary shift is dispelled by radio engineers and physicists, many of whom agree that nothing can be gained, as far as increased satisfaction of the listener is concerned by converting the present system of transmitting and receiving into a frequency-modulation system. Such comments are made, however, with reservations, because even the far-sighted scientists are not willing to predict what will happen in radio five years hence.

In commenting upon the frequency-modulation method, a prominent radio engineer said, "I do not see one single advantage to be gained. The contention that the initial electrical energy at the transmitter can be reduced greatly is not substantiated by the findings of all engineers and physicists. I doubt if less power is needed at the transmitter to produce a given signal strength in receivers through the utilization of frequency modula-

tion. Interference and static conditions would be no better under a complete system of frequency modulation than now experienced under our present system of amplitude modulation, according to my observations and the experiments of other investigators. A receiver built to respond to transmissions of the frequency-modulation type would be very inefficient when utilized to detect signals of amplitude modulation, which is now in general use throughout the world. Conversely, a receiver of the present-day type is not adapted to reception of frequency-modulated broadcasts."

JOHN R. CARSON, physicist in the research department of the American Telephone and Telegraph Company in a discussion of the theory of modulation before a meeting of the Institute of Radio Engineers said:

"It has been proposed a number of times to employ an apparently radically different system of modulation as distinguished from amplitude modulation, in the belief that frequency modulation makes possible the transmission of signals by a narrower range of transmitted frequencies. This belief is erroneous; the suggestion is, however, quite ingenious, and the reasoning on which the supposed advantage is based

is very plausible, and indeed requires some mathematical analysis before its incorrectness can be satisfactorily established. A mathematical analysis shows, however, that the frequency band which must be transmitted is at least equal to that required in amplitude modulation. It is proved that the frequency-modulation system using a spacing or compensating wave is inferior to the amplitude system both as to width of the frequency band occupied and as to distortion of signal wave-form."

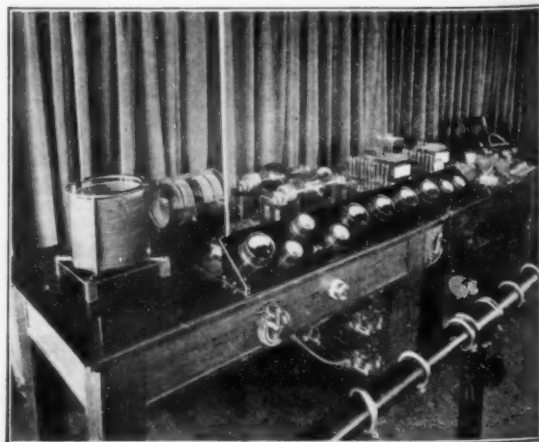
Dr. Lee de Forest, inventor of the three-element vacuum tube, in commenting upon the KDKA system said:

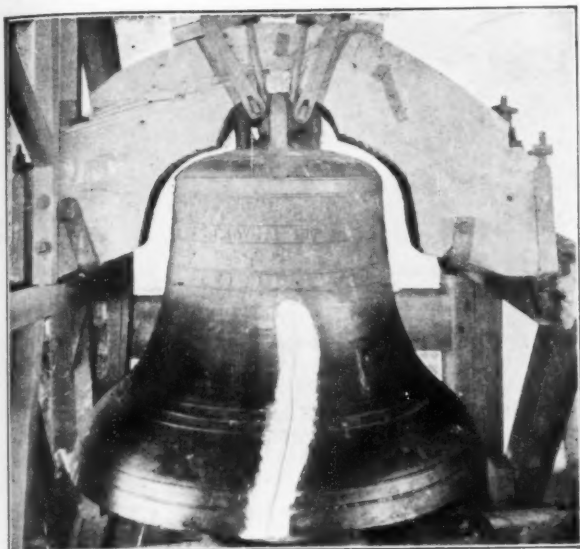
"I have felt that in time we would come to compound tuning as a solution to the problem of too many stations broadcasting on the present-day bands," said Dr. de Forest. "Such a system is not substantially new if it is the same as that employed by Professor Reginald Fessenden from 1901 to 1908.

"The carrier wave of a broadcasting station alone requires less than one half kilocycle separation to avoid interference," explained Dr. de Forest. "On this carrier, a high-frequency modulated wave of the order of 30, 40 or 50 kilocycles may be imposed, which carries exclusively the modulations corresponding to the speech or music. These modulator frequencies, remote from the frequency of the carrier wave, may be arranged very easily so that no interference will result between the stations. In fact one station might radiate two or three such high-frequency carrier waves with an individual program on each wave, all at the same time. One program might be a lecture, one a symphony orchestra and the other a concert of a lighter nature. However, this system would entail rather complicated and expensive receivers, but it would be one possible way to overcome congestion in the ether. The receiver might be equipped with a three-way switch, so that the listener could select the program desired after the set is once tuned to the unmodulated carrier wave of the station."

LONG AGO

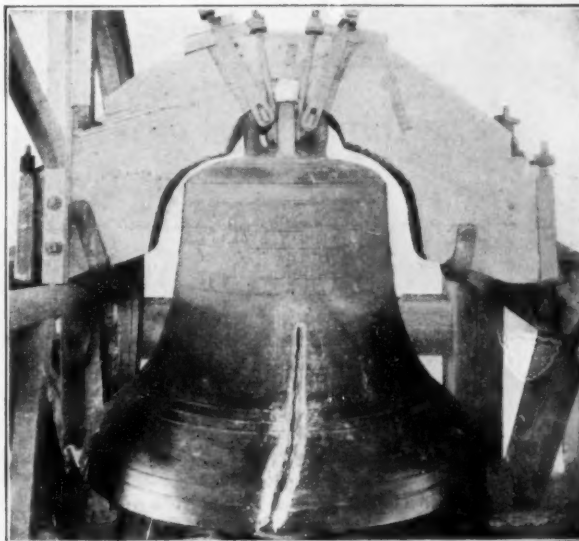
This is the way that broadcasting stations were built in the days when station WGR first went on the air. Everything is laid out so that it will be accessible for repairs, and in those days, repairs often were necessary. The two tubes, the heart of the transmitter, are mounted horizontally in the center of the table. Just to the left of them are the tuning inductances, the one of these on the right having adjustable solenoids





PREPARED FOR WELDING

A large double Bunsen burner was used in order to preheat the bell casting in preparation for the actual work of welding



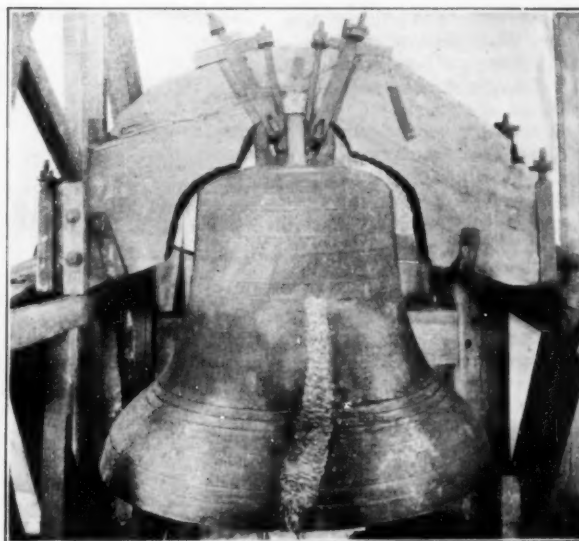
OPENING THE CRACK

The carbon-arc type of welding cleaned the crack and opened it up so that the welding material could readily be deposited



BUILDING UP

For this process the metallic arc was employed to build up and fill in the space opened up by the initial cutting operation



COMPLETED

Extreme care in each operation is essential. All must be done expeditiously so that the bell will not lose too much heat

Out of the Silence Comes a Voice

After a silence of over 40 years, a 922-pound bell in the First Unitarian Church of Taunton, Massachusetts, was repaired by electric arc welding. It now rings apparently as well as before the break. The church was founded in 1637, the bell being cast in 1804 by George Holbrook, who learned his trade as an apprentice to Paul Revere. The crack was discovered in 1886 and since that time no attempt has been made to utilize the bell. However, for two years there had been agitation to repair the bell. The General Electric Laboratory, at Lynn, Massachusetts, where much original research is now being done, was called upon for assistance. Specimens of the metal were taken and an investigation of the crack was made. The bell is 34 inches in diameter at the mouth, 18 inches in diameter at the top and 26 inches high. The crack was

17 inches long and had a section varying from one inch in thickness to two and five eighths inches maximum near the outer edge. The metal was found to contain 83 percent copper and 17 percent tin. Some interesting problems were therefore to be solved. After the crack had been prepared for welding, a standard motor-generator, constant-energy type of welder was employed in the actual welding, an electric power line having been installed in the belfry, 56 feet from the ground. Power lines were run down from the belfry to the welding outfit on the ground, and the welding leads were extended up to the bell. The operator started with the carbon-arc type of welding, and finished with the metallic-arc process. Phosphor-bronze welding rods were used, having an analysis of about 95 percent copper and 5 percent tin.

Africa

The Impressions of a Modern Woman, After Two Years Spent Among the Natives in the Jungle

By MARTHA MILLER BLIVEN



The Author

THE struggling locomotive puffed, coughed, gasped—and died. My husband and I, a couple of green-horns in the ways of Belgian Congo trains, gazed out of the windows over an uninhabited and barren country, and wondered when we would be moving on. It was to wonder! We sat like this for hours, watching the heat-waves dance above the hard-baked ground around us. A blasé fellow-passenger informed us that these trains were always anywhere from an hour to a day late in arriving at their destinations.

It began to grow dark; and restless passengers strolled back and forth the length of the train. Several Englishmen thought that they would like a game of bridge to while away an hour or two. They borrowed the engineer's lantern and began their game on an old box placed near the train. The second hour passed—and still no signs of motion on the part of the locomotive. A crowd gathered about the informal bridge table for amusement—and the black engineer was among the interested audience. Another hour passed. One of the weary players, looking up, "spotted" the engineer.

"How are you ever going to have that train in motion when you stand here watching us?" he asked.

"Oh, the engine is fixed and all ready to go; I am just waiting for you to finish your game so that I can have my lantern to wave while I call 'all aboard.'"

This was truly Africa, where time was of no importance to the native. Here was a country where the hurry and bustle of the foreign world was forgotten. The two-day train trip from the West Coast port, Matadi, to Kinshasa, the town on the lowest navigable portion of the Congo River, should have warned new-comers of this situation, but I fear that they understood it much better when they made their

where you see boats flying the flags of England, the United States, France, Belgium, Italy and Portugal.

Along the Congo and its tributaries the crocodile is considered an evil spirit. When a native is knocked into the water and drawn under by a crocodile, it is surmised by the rest of the village that it is the evil spirit that is following his family, demanding a sacrifice. Many a crocodile that has been shot and cut open has been found to contain brass and copper armlets and anklets.

Naturally, the crocodiles are considered vermin in this country where they exact such toll from human life. So we felt no scruples in practicing shooting with crocodiles as targets. During the dry season the waterways were dotted with sand banks on which the crocodiles were lying and sunning themselves. It was easy enough to hit them, but nine times out of ten they managed to get into the water before they died.

One day, however, when we were traveling on a small steamer, I was fortunate in breaking the backbone, high in the shoulder, of a crocodile. Then it could not flop from the sand bank into the water. The Danish captain obligingly stopped the boat so that we could put off in a small craft and bring the "croc" on board for closer inspection and to be skinned.

There was lively interest expressed by the black crew at this episode to break the monotony of the day. One old native began telling us the history

A Woman Explorer

THE versatile author of the accompanying article was for several years secretary to Carl Akeley, the great naturalist and sculptor whose untimely death was noted in our issue for March, 1927. Martha Miller Bliven was taught to shoot by Mr. Akeley, and she soon became a first-class hunter of big game. She also assisted him in his literary work. In the present article she describes the colorful life which she and her husband found in this wonderful continent. We are fascinated and made not a little envious by her story.—The Editor.

exit from the country after several years of living and learning than their optimistic minds would let them grasp at first.

On an old Mississippi stern wheeler, which moved slowly along in the daytime and tied up at some native village to "sleep at night," we traveled upstream for 28 days—the entire length of the navigable portion of the Congo River. In one place, the Congo is less than a quarter of a mile wide, while in another section it is over 25 miles wide.

Because of its great size, the Congo River is an international waterway



PYGMIES OF EAST BELGIAN CONGO

These pleasant little people danced all one long Thanksgiving Day for a spoon of salt. The dance is largely made up of "shimmying"



TESTIMONY OF THE HUMAN YARDSTICK

Little Alice Bradley, age five, is posing with two adult pygmies, so we can be certain that they are of the size usually attributed to them



A FALLEN MONARCH OF AFRICA

Here we find the author considering the best way of taking care of one of her best prizes, a splendid example of the African lion

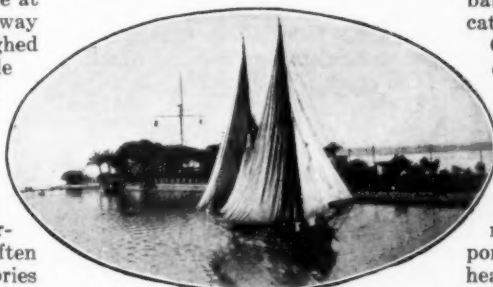
of all crocodiles, their habits and customs. Of course, it was told in the Bangala language, which, fortunately, we had learned to speak and to understand.

From the flow of words we gleaned that a crocodile swallowed a pebble at every new moon, and this was his way of keeping tab on his age. I laughed at this as I had a vision of a crocodile dying of old age because he had swallowed so many rocks that he could not wiggle.

However, we were interested. Experience with the natives had taught us that they know a great deal about the animals in their particular regions, and that there is often some truth behind the fantastic stories that they tell you. We decided to investigate this fable (for I had never heard a story like this one in South Africa or in East Africa). Albert did the skinning and the carving, while I became the spellbound audience. And now, believe it or not, when that crocodile was cut open, his stomach yielded more than 300 pebbles of different shapes and sizes. A tall "Hauser" native, of Arab strain, asked for these pebbles. When I inquired what he wanted to do with them, he re-

plied in the following startling way: "I wish to put them in a bottle of water to make medicine. This medicine is a cure for natives who have sleeping-sickness."

Here was more information, or mis-



A GATEWAY TO AFRICA

The entrance to the Suez Canal is far from being as spectacular as that of the Panama

information, as the case might be. As we were in a tsetse fly area then, and as the subject of sleeping-sickness was especially interesting, I decided to send the pebbles to a prominent physician in New York to be analyzed. This resolution on my part never materialized, as it was several weeks before we reached a post office. By that time, the increased strength of the odor of the pebbles so offended my nose that I threw them away in disgust.

THE second year of our sojourn in Central Africa was spent in French Equatorial Africa—a most interesting year—and a delightful change from the year of meandering the Congo River and its many tributaries in the Belgian Congo. Also, my young sister-in-law, Ann Bliven, joined our party. She was such a true sport, a charming companion, and so enthusiastic about all she saw and did, that Africa seemed to respond to her praise by betraying to us its most fascinating side—the true bush life of Africa.

Every day was like a page out of an interesting book. We encountered the real natives, unspoiled by the touch of civilization; we learned about the different birds and flowers; we photo-



ELEPHANT HUNTING IN BELGIAN CONGO

Mrs. Bliven and Carl E. Akeley are shown discussing our author's well-placed shot. An elephant is not an easy animal to kill

graphed and hunted wild game in its natural setting; we visited tribal dances and funerals; we doled out medicine and dressed wounds and ugly sores; we studied young animal life from close association with our pets in camp—baby monkeys, young leopards, serval cats, and so on.

Our routine of camp-life changed completely. Now all equipment of tents, cots, blankets, provisions, medical supplies, ammunition, photographic and developing kit, clothing, table-ware, kitchenware, and money was packed in boxes which weighed, when packed, not more than 55 pounds each. The porters carried these loads on their heads day after day; and our marches varied in length from 15 miles to 25 miles a day.

To these "beasts of burden"—and I might add that they were a fairly happy and contented lot—we paid two cents a day per man. Or, if we were staying in one district for any length of time we hired our 60 porters at 50 cents a month per man. Each porter furnished his own food and looked out for himself. Of course, when we were in a game country we shot meat for their food, of which there was never a



THE AUTHOR'S CROCODILE

On the Ebangui River crocodiles afford an easy mark, yet they often escape before dying. A rifle shot broke this one's back



DEATH OF A WART HOG

This ugly looking animal abounds in the Belgian Congo and his death caused no regrets. His flesh made excellent eating

particle of flesh wasted. The insides of the animals were quite as delectable to the native as the outside meat; and I can assure you that the hyenas, the safari ants and the vultures had "poor pickings" when the porters departed from the skeleton of a recently killed antelope, buffalo or elephant.

WHEREVER we stopped for the night, or to camp for a few days, that spot was referred to as home. Therefore, it was made comfortable. In fact, it was camping *de luxe* compared with the "roughing it" trips one takes in America. There were plenty of personal servants—boys of varying ages and sizes and tribes—to wait upon us, to prepare warm baths in portable tubs, to clean boots, to keep the tents neat and to prepare and serve meals.

I was often annoyed and later on amused at the antics and the stupidity of some of these boys. One little tent boy in particular, Pambu, managed to annoy me more than the others, but he was so funny that we kept him with us for the 27 months that we spent in Africa. He enjoyed eating the tooth paste—a valuable and irreplaceable article of necessity—and on numerous occasions he was caught scrubbing out the wash basin with a tooth brush. I never realized how attached I had become to this stupid, loyal little scamp until it was time to say "Good-bye" and to turn over my wornout possessions that he desired as presents. I felt like weeping when we parted, and he said:

"Nquenda malam, madame"—
"A good journey, madam"—with tears in his eyes.

Of course, the kitchen and what to eat was a problem, as it is anywhere. During the second year of our stay in Africa, the food began to have an appalling sameness of taste. In all fairness, though, I think the cook did extremely well, inasmuch as he cooked the meals over an open fire surrounded by three hot stones. When he wanted

to bake bread or make a cake he built a crude oven by tunneling through an uninhabited, hard-baked ant hill. Then he filled the cavity with glowing embers, placed the bread tins among the live coals and closed the openings he had made on both sides of the ant



A TYPICAL AFRICAN TREE

The table-top acacia tree illustrated above is one of the unusual and distinctive features of African scenery

hill. For yeast for the bread, he used a bit of banana pulp which had fermented in the sun. This he kneaded with some dough, kept it in a warm spot, and referred to it as the "mother of the bread."

I soon discovered that the real necessities of life took care of themselves, or were worked out for you by the natives, and the things that I had always considered as "absolutely necessary" at home were not necessary at all. After all, it is only your point of view. Without doubt, we were comfortable, had good appetites, had very little sickness, and the fact that we are anxious to return to Africa is ample proof that we enjoyed it and found life very interesting there.

"But what did you eat?" I have been asked.

As a matter of fact, our meals usually were very similar to those we would have had at home, except that all of the milk, butter, jams and most of the vegetables were tinned. Our fresh fruits consisted of bananas purchased at ten cents per bunch, oranges at 20 cents per hundred, avocados at about the same price, pineapples at one cent each, and so forth.

On several occasions we strayed far from our base of supplies and stayed away longer than had been anticipated. Of course we ran out of tinned foods, but this condition never hurried our return, as we always managed to live off the country very well. For instance, wild honey replaced sugar, native potatoes and rice were obtainable and game was plentiful. Mushrooms the size of a luncheon plate were found to be very edible, while the hearts of young pineapple plants or of young palm trees afforded a refreshing salad.

Of the animals that we shot, we tasted nearly all. We had the brains of the buffalo *sauté*, the heart of the buffalo fried and the warm marrow from the heated leg bones. Of the antelope we generally used the tongue and the tenderloins, giving the remainder of the meat to the boys and the porters. From the wart hog the cook prepared roast tenderloin of pork.

TO change the meat diet, wild ducks and guinea-fowls tasted delicious. Of the meats that I ate but did not enjoy so much, as my imagination played tricks on me, were gorilla flesh, the heart of the lion and the trunk of the elephant. We absolutely drew the line at eating python-snake steak, even though the natives assured us that it was palatable.

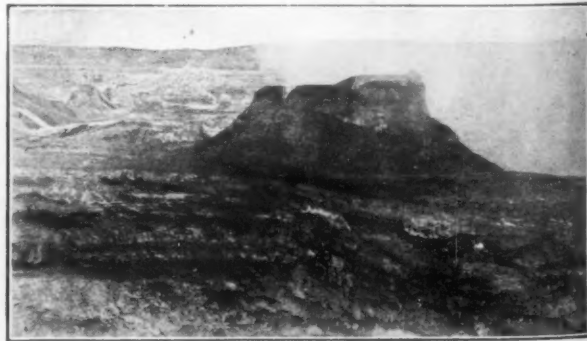
Now, when I am crowded into a subway and am jostled and pushed about, I find that visions of Africa—the freedom, the thrill of exciting moments, the fascination of unspoiled Nature, of game—appear tempting to me and blot out the unattractive scenery before my immediate vision.

One of the "high spots" of our expedition will always remain vivid to me: the moonlight nights when we watched the night life of the plains while waiting behind a thorn screen "boma" for the lions to come to feast upon a dead antelope staked about 15 feet in front of us. Discernible in



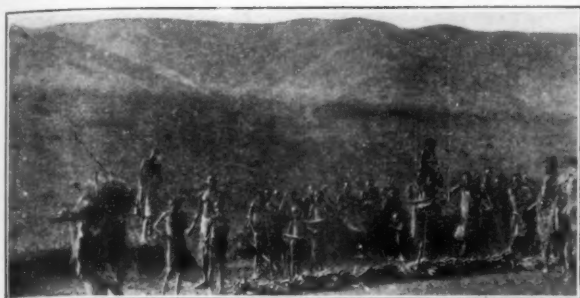
BIRTH OF THE NILE

The Nile proper is shown at its outlet from Lake Victoria Nyanza, from whence it flows to the sea, a distance of 3473 miles



INSIDE THE CRATER OF A VOLCANO

In some of the volcanoes of Africa it is possible to go down into the crater even though the cone, shown in the center, is active



THE FOOD LINE

Bananas are one of the principle foods. A strong and potent alcoholic beverage is also made from this innocent appearing fruit



GRAVE OF LION'S VICTIM

Under the cross of this grave lies the body of an Englishman who surrendered his life to the inexorable laws of the African jungle

the distance were the outlines of the sentinel antelope standing guard against a surprise attack of the antelope's enemy, the lion.

In the immediate foreground the hyenas, jackals and serval cats pulled and gnawed at the dead antelope. Nervously they darted in and out of the surrounding shadows as if they

The greedy hyenas and jackals put their teeth into the flesh for one last tear before they, too, slunk off into the shadows of the brush.

For a time, only the thud of the galloping herds of antelope could be heard as their hoofs beat upon the hard-baked ground. Then all was quiet. Not a sound nor a crackling of a twig broke the surrounding stillness. Behind our thin screen we were expectantly quiet. I was tense as I placed my hand near the trigger of my gun, for all signs indicated the approach of the lion for which I had been waiting up and watching for five entire nights.

of a moonlight night. At the first rays of the morning sunrise, we crawled stiffly through a hole in the thorn screen so that we might examine the trophy, stretch our weary bones and have breakfast.



THE AUTHOR'S CAMP PET

This sleepy little year-old leopard was not taken back to civilization

were on the alert for the arrival of their foe. From a distance to the right of us came the grunt of a lion as he picked up the blood trail of the antelope. There is some resonant note in the grunt of a lion that sends little prickling needles of excitement up and down your spine. Hastily the cat family faded from view.

FROM the shadow of the brush emerged the silhouetted form of a lion—no longer were his grunts heard, for he was stalking his prey and went about his time-old game in a cautious and silent manner. So quietly did he slip from the shadows into the scenery before my eyes that I could hardly believe it. He halted just in front of the boma and looked cautiously about him. He sniffed at the bait, then looked in our direction. I dared not wait longer. There was a flash and a roar from my Springfield and the lion fell beside his prey.

It was out of the question to examine him then, as it was unwise to leave our posts. However, we could flash a light upon him to be sure that it was really a dead lion and not a myth



A "BEAUTY" TREATMENT

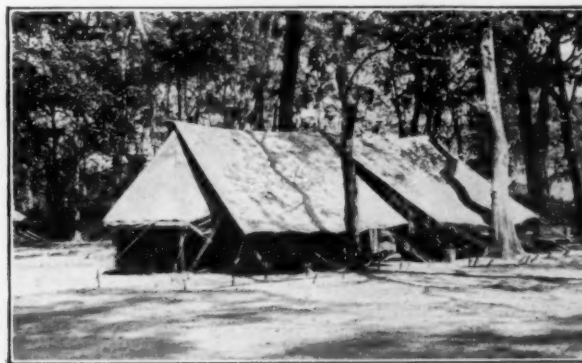
A tribal marking which is much esteemed is inflicted with hot rubber

My lion proved to be a good specimen of the plains variety, weighing more than 400 pounds and possessing a splendid coat and mane. The tick bites I received and the annoyance of the mosquitoes and the stiffness from a cramped position quickly passed, but I shall never forget those tense and interesting magic nights of watching and waiting on the plains of that fascinating continent—Africa.



A THREE STONE CAMP KITCHEN

The servant problem presents no terror in Africa. This cook costs 2 dollars a month, with the little dishwasher, and they feed themselves



A CAMP IN FRENCH EQUATORIAL AFRICA

Mrs. Blixen refers to camp life in her article. Most of the comforts of home are provided. Fifty dollars a month pays all expenses

Successful Inventors---X

A College Professor Solves a Mathematical Problem and Becomes a Wealthy Inventor

By MILTON WRIGHT

MOST of us are likely to think of an inventor as eagerly seeking some idea upon which to exercise his genius, and then bending over a work bench surrounded with wheels, wires and miscellaneous gadgets trying first this combination and then that until he works out his invention. He gets his patent and makes the rounds of manufacturers, all save one of whom laugh at his radical ideas, but that one sees something in it and makes a fortune.

The other day we were talking with an inventor who is not like that at all. He never thought of himself as an inventor, never looked for anything to invent, never had any intention of making a lot of money, believes he is weak in imagination—that quality so often considered necessary to successful invention—has put in far more time writing a book than he has done in inventing, has done his inventing only as a sort of side line and never bothered peddling an invention around among manufacturers. All the inventing he does is with a pen and a note book. And yet Louis Alan Hazeltine has made a fortune out of his inventions. The best known of them, of course, is the Neutrodyne radio receiver.

THAT there was a fortune in the Neutrodyne is not surprising. You recall the confusion in the early days of broadcasting. You would be enjoying a concert on the air when a long shrill squeal would drown out all the music. The trouble was due to the fact that most receiving sets were of the regenerative type. Each receiver was in reality a miniature transmitter and when they were improperly handled—as they generally were—complications were sure to arise. Manipulation of the dials to get the best results quickly meant the sending out of waves which were picked up by other receivers. In crowded neighborhoods there was a continual squealing as listeners were tuning their sets or “fishing around” for distant stations.

Then came Hazeltine with his Neutrodyne and the trouble disappeared. Radio receivers became highly sensitive, reception was under complete control and, because of this

control, squealing became impossible.

“What would you say, Mr. Hazeltine, is the secret of successful inventing?” we asked.

“That is a hard question,” was his reply. “It is especially hard for me, because I work differently from most inventors. I believe, however, that the first requisite is a thorough knowledge of fundamental principles.

engineering in spite of my former prejudices.”

From Stevens he graduated in 1906. Usually elementary school, high school and college take 16 years of a young man's life. Hazeltine, however, did them in 12. Leaving Stevens, he entered the testing laboratory of the General Electric Company in Schenectady. A year later he took a position as assistant in the Department of Electrical Engineering at Stevens Institute. On that college's staff he remained until two years ago.

In 1915, E. H. Armstrong read a paper before the Institute of Radio Engineers on the fundamentals of the three-electrode vacuum tube and in particular disclosed the tube's capabilities for regenerating and oscillating. It opened for Hazeltine a field for complex mathematical analysis in which he could revel to his heart's content.

He began a theoretical study of the vacuum tube's operation and worked out the theoretical requisite for producing oscillations. Then, for the first time, he obtained a vacuum tube and traced its characteristic curve. With all the necessary information assembled he designed and wired his circuit. In practice it worked out exactly as it had on paper, and oscillations were produced on the first trial.

FOR two years more he continued his theoretical studies, using actual experiments from time to time only to verify his calculations. In 1917 in a paper on “Oscillating Audion Circuits” he gave the Institute of Radio Engineers the results of his work. For the first time a general yet simple mathematical method for the treatment of oscillating audion circuits was stated. All of Hazeltine's later work in radio he traces to that paper.

“How did you come to take out your first patent?” we asked.

“In 1917,” he replied, “I was experimenting with Paul Ware, one of my students, on wireless telephony. The result obtained looked practical and I took out a patent and assigned it to him on a royalty basis. The invention was used later in the Army Signal Corps for wireless telegraphy.”

“And that really started you on



THE INVENTOR AND HIS TOOLS

Louis A. Hazeltine does all his creative work with a note book, a fountain pen and a slide rule, thus avoiding trial and error methods

“I never had any intention of being an inventor. Mathematics was always my favorite subject in school; it was in mathematics that I used to get my highest marks. When I entered Stevens Institute of Technology I thought that eventually I would like to get into teaching.

“What I wanted to take up I had no idea, but I was prejudiced against electrical engineering. Near the end of my course I began to feel that the performance of electrical apparatus could be predetermined more accurately than that of mechanical apparatus. Here was plenty of opportunity to work out mathematical problems, so I took up electrical

the pathway to becoming a patentee?"

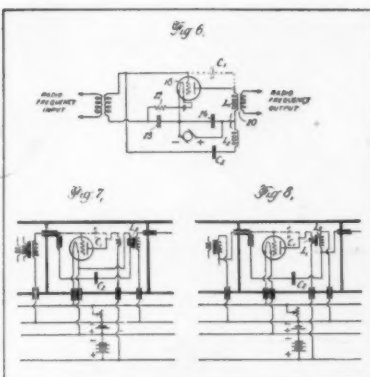
"No, I wouldn't say that. That was more or less an isolated invention. In the World War I joined the technical staff of the radio laboratory at the Navy Yard at Washington. There I designed a radio receiver which the Navy standardized and which came into wide use. My superior officers asked me to prepare patent cases on what I had done; that is how I really began to apply for patents.

"I began to devote my time to a study of the application of three-electrode vacuum tubes to the various problems of converting power; efficiency, of course, was the primary object. In the fall of 1922 my attention was directed to the tremendous possibilities of a receiver using tuned radio-frequency amplification. The limitation of this type of receiver which had prevented its becoming a success, was the fact that it had a tendency to oscillate due to the feed-back of the vacuum-tube's capacity coupling. Tuned input and output circuits accentuated this feed-back. My earlier work on the neutralization of this capacity coupling was directly applicable. A model receiver was made. It became known as the Neutrodyne.

"**R**ADIO broadcasting was developing rapidly and manufacturers were seeking eagerly for a receiver that would do just what mine would do. A year after the Neutrodyne came out, a corporation known as the Hazeltine Corporation was formed and I sold my patent rights to it, partly in exchange for a substantial stock interest."

"Would you advise an inventor to go into the manufacture of his invented articles?" we interrupted.

"No," he replied. "Usually an inventor is lacking in commercial ability. Generally someone else doing the manufacturing can make more money for him than he could for himself when working alone."



PICTURES WORTH A MILLION

Upon these drawings the Government allowed claims which made the inventor rich

"And which would you say is more profitable for the inventor: an outright sale of his patent or leasing the patent on a royalty basis?"

"That depends more on the purchaser than it does on the inventor. While it is a pleasant thing to be paid a lump sum in cash, still there might be more in the long run in a royalty. However, the inventor as a rule is not in a position to dictate.

"Sometimes the financial circumstances of an inventor have a lot to do with how much he gets. For several years before I developed the Neutrodyne I had been in consulting practice. This had been fairly lucrative and I felt reasonably independent. If an inventor is hard up he may feel obliged to let go of his invention for a fraction of its value."

"What steps do you think an inventor should take to protect his invention?"

"My advice would be to get a high-grade firm of patent attorneys and follow their advice. The Patent Office recommends such a course, you know. When I was ready to patent the Neutrodyne I went to a former student of mine who had joined a

well known firm of patent attorneys.

"You must remember that I do not hold myself out as an example. Every man has to work in his own peculiar way. I have always thought of myself as a teacher rather than as an inventor and I conducted classes regularly. I was accustomed to think of an inventor as rather impractical. I gained this impression from the many inventors who came to me for help and advice; most of them I thought were foolish. Now that I have stopped teaching and am devoting all my work to inventing I suppose I have to call myself an inventor."

"**B**UT all the time you had been training yourself for invention."

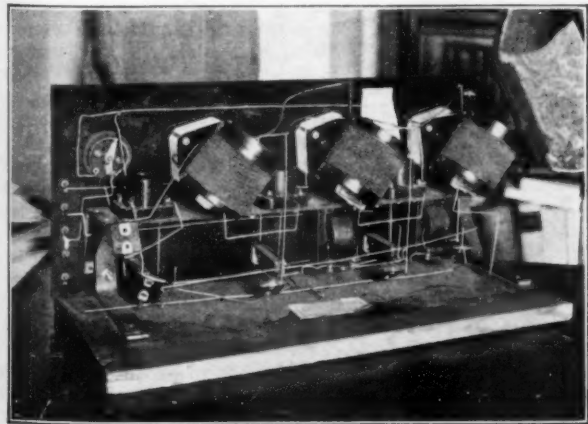
"That is true. For anything I have been able to accomplish a thorough foundation was necessary. I spent years in theoretical investigations. The time I spent on physical engineering problems was enormous, and it is surprising how many of the principles and methods I worked out proved extremely useful later."

"To be financially successful should not an inventor make a definite search for the right thing to invent?"

"I don't know. I have never been looking for new ideas and most of my work has not been done with any thought of money. I expected to spend my life as a college professor on a notoriously small salary, for I knew it was work in which I would be happy."

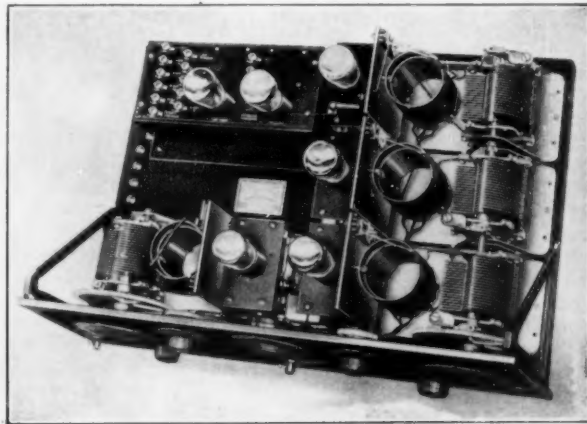
"Here is a text book on electrical engineering published some time ago. I spent vastly more time on that than I did on all my inventions and I think there is far better work in it than there is in the Neutrodyne, but as for money, well that is something different."

"That I have become an inventor probably is a logical development. I should say that if any man is a competent engineer working on new development work, he cannot help making inventions."



THE FIRST NEUTRODYNE RECEIVER

With this model there was no experimenting. It was all thought out in algebraic formulae, and when it was constructed, it worked



THE NEUTRODYNE OF TODAY

Lift up the cover of any one of ten million radio sets in use today and you will see this adaptation of Hazeltine's famous invention



W. H. Wood

A COMPLETE TESTING PLANT

The author conducting a dynamometer test by his new method, which includes all the various considerations

effecting efficiency, from the front wheels, through the motor and the driving mechanism to the tire contact

400,000,000 Horsepower!

*This is the Aggregate Power Developed by Automobiles
Tests on 250 cars show some interesting results*

By E. H. LOCKWOOD

Associate Professor of Mechanical Engineering, Yale.

THE development of the motor vehicle has afforded an example of the popular use of mechanical power on an enormous scale. In the United States alone over twenty million motor cars were registered in 1926, in units from 15 to 100 horsepower each, or an aggregate of perhaps 400 million nominal horsepower. The variation in power of these cars is considerable, but is easily explained by differences in weight of the vehicles, and in the road speeds for which they were designed.

The horsepower of motor-car engines usually has been determined by the "block test," on the electric dynamometer, of representative samples, before assembly in the chassis. These tests have rarely been made after the car was built, owing to practical difficulties in removal and replacement of the engine and other preparations, such as lining up the engine on its foundation, bolting a coupling to the flywheel or shaft, et cetera, all adding to the expense and trouble of this method of testing. But this method is a standard one and universally used. Moreover the mechanical efficiency of the automobile as an entire machine or

the efficiency of the various subdivisions can readily be obtained.

Portable instruments have been devised for power tests on the road, employing in most cases the inertia of a heavy weight or liquid to indicate the acceleration of the car, from which the horsepower can be computed. These instruments have value for

approximate measurements but are not comparable with the block test for reliable information.

The difficulties connected with block testing may be largely avoided by the use of a different kind of apparatus, known as the chassis dynamometer. While somewhat more elaborate than the block-test apparatus, when once installed the new method is far more convenient to use. A complete power test can be made in an hour or two without any dismantling of engine or chassis, thus making it possible to test the power plant of any motor vehicle with a minimum expenditure of time and trouble. In spite of its advantages, the chassis dynamometer has been but little used for engine testing.

A good example of successful use of this type of apparatus is to be found at the Mason Laboratory, Yale University, from which source the illustrations in this article have been obtained. Since this dynamometer was installed it has served for power measurements on hundreds of motor cars, including not only power of the engine but also the power lost in transmission and in the tires.

The principal part of the



THE DRIVING MECHANISM

FIGURE 1: The traction pulleys are hung beneath the testing floor and have individual drives as shown. See also Figure 4.

apparatus, as shown in Figure 1, consists of two pulleys of large diameter, mounted on a rigid shaft and supported from the ceiling by ball-bearing hangers. The tops of the pulleys are exposed through openings cut in the floor, which permits the two rear wheels of the vehicle to be centered on the pulleys, while the car itself is securely anchored to prevent motion. When thus arranged, the engine can be started and run at any desired speed, delivering power through the rear tires where it is measured on the pulley shaft by suitable appliances.

The operator's stand is shown in Figure 4, including a scale for measurement of torque and an electric tachometer for speed. Torque refers to the resistance to rotation of the pulley shaft, which is varied according to the desired load on the engine and is registered on the scale. Variation of the torque is effected by change of tension of a band of ropes encircling the brake pulley, produced by a hand wheel at the operator's table. The brake pulley and encircling ropes can be seen at the end of the drum shaft, Figure 1. This form of rope brake has been found in practice to be very flexible and convenient. The capacity of the brake system has been estimated at 140 horsepower, but thus far the greatest demand has been only about 110 horsepower. Its maximum capacity expressed in tractive force exerted at the pulley surface is 2000 pounds.

A minor part of the apparatus is a variable-speed electric motor belted to the main shaft, which ordinarily is not used and revolves idly with the pulleys. When desired, the wheels of the car can be rotated by the electric motor, for measurement of friction loss in the tires and transmission. Such friction measurements can be applied to both front and rear wheels, and give useful information as to power losses in the car.

FUEL measurements have been made by a special weighing tank having a flexible pipe leading to the carburetor, which permits of automatic measure of fuel weight and time for any run. An alternative device, suitable for full-power runs, has been a calibrated flow meter for instantaneous reading of the flow rate.

Engine cooling by the radiator and fan is insufficient in the absence of air currents such as are met on the road. The deficiency can be made up by adding a little water at the radiator drain cock, which produces a pro-

portionate overflow of hot water from the upper tank. The practice at the Mason Laboratory has been to maintain a constant water temperature in the upper radiator tank of approximately 175 to 185 degrees Fahrenheit.

In testing a motor vehicle, it is important to know what tractive force delivered at the rear tires will propel the vehicle at constant speed, either on the level or an up grade. This information can be had from the general principle that the tractive force required at the rear tires must equal the sum of the resistance of the front wheels, plus that of the air, plus that of grade. Each of these resistances can be obtained, at least approximately. The front wheel rolling resistance can be measured on the chassis dynamometer. The air resistance can be computed from the car

output of each of the possible operating speeds; second, when the load at each speed is adjusted to be the equivalent of that required on a level road. From its behavior under these conditions, the power-plant performance in intermediate states can be safely estimated.

ENGINE horsepower is difficult of direct measurement, but can be easily computed from the torque in foot pounds and the speed in revolutions per minute. When the engine is mounted in a motor car, a portion of the engine torque is lost in friction before reaching the rear tires, as before mentioned. Tests prove that the transmission friction loss increases slightly with the speed, and quite considerably with the power transmitted. Under average conditions it may be assumed that the friction of transmission under full load is 25 percent greater than under light load.

The light-load friction loss in transmission is easily measured on the chassis dynamometer at all speeds. The full-load friction loss is difficult of measurement, hence it is permissible to use an approximate value found by adding 25 percent to the light-load figures. There is some uncertainty attending the measurement of the transmission friction loss, but fortunately the friction loss is only a small portion of the total engine power.

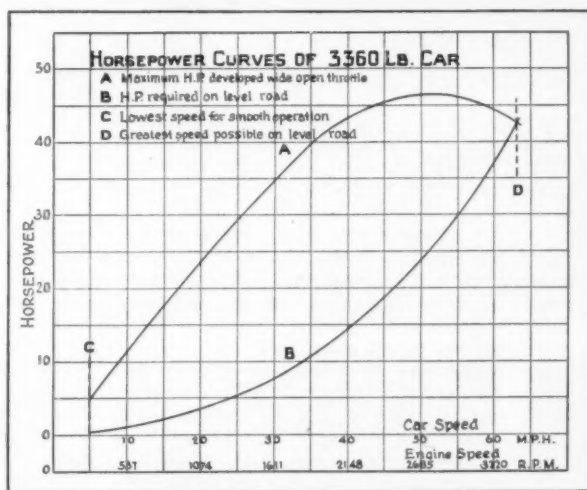
Engine horsepower on the chassis dynamometer is necessarily measured in two parts: first, that lost in transmission friction, second, that delivered at the

rear tires as tractive force.

An example of engine horsepower determination in accordance with the foregoing method, is given in the accompanying diagram, Figure 2. Part of the diagram, curve B, relates to the power required to drive the car on level road. This curve starts at about one horsepower at five miles per hour, and continues to 43 horsepower at 63 miles per hour when the maximum speed is reached.

Similarly, curve A relates to the greatest possible power of the engine, starting at about five horsepower at five miles per hour and reaching a maximum of 46 at 50 miles per hour. As before stated, the horsepower was computed from the car speed and the tractive force as measured at each speed.

The curves stop abruptly at point C, this being the lowest speed for smooth running in high gear. The curves A and B meet at point D,



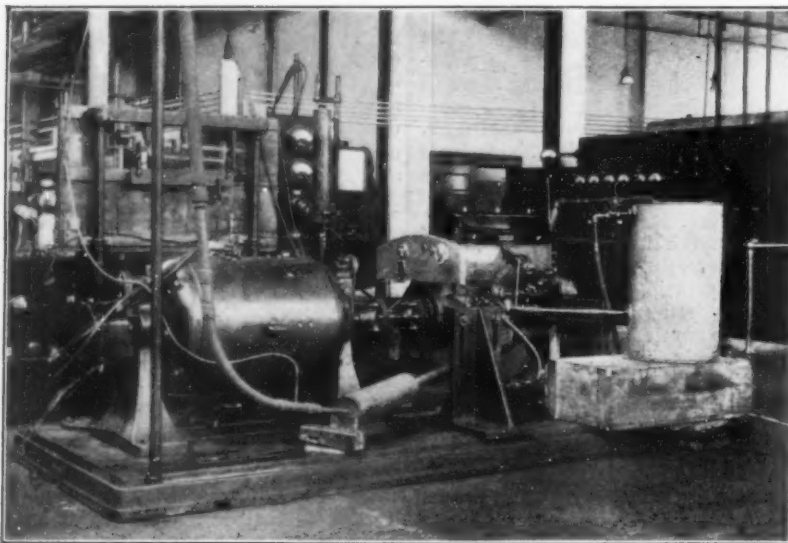
THE STORY OF THE TESTS

FIGURE 2: At full throttle a point is reached where increased engine speed diminishes the horsepower output just before maximum car speed is reached. See text for further explanation

speed and body area, assuming still air. The grade resistance can be computed from the percent of grade and car weight.

The power plant must deliver this tractive force at the rear tires. Indeed it must exert considerably more power than that delivered at the rear tires, since it must overcome all friction of gears, bearings, lubricant and flexing of tires before any tractive force can be applied to the road. The engine power may be divided into two parts—that lost in transmission between clutch and rear tires, and that delivered at the rear tires as useful tractive force for propelling the car. In chassis dynamometer testing it is necessary to measure these two power elements separately, considering their sum as the total engine power.

In testing a motor vehicle it is usually sufficient to run the power plant under two extreme conditions only. First, at the maximum power



THE BLOCK TEST

FIGURE 3: Speed, horsepower and fuel economy can be accurately determined by the electric dynamometer, after the power plant has been removed from the car

whose intersection determines the maximum speed on level road. Two scales are given on the abscissa axis, one referring to car speed in miles per hour, the other to engine speed in revolutions per minute. In this example, the car speed was 63 miles per hour, with a corresponding engine speed of 3400 revolutions per minute.

Diagrams similar to Figure 2 have been constructed for many cars, both light and heavy. A singular fact has been discovered from study of these diagrams, namely, that curve B has been approximately alike on all. It follows that high car-speed, as indicated by point D, can be had only by raising curve A, that is, by using a larger engine. The rapid rise of curve B at high speeds indicates that considerable increase of power will be required for even a moderate gain in speed.

INSPECTION of the curves shows that both have the common characteristic of increasing with the speed at a nearly uniform rate over the range from 20 to 50 miles per hour. It follows that the reserve horsepower available for acceleration, grades, head winds, et cetera, is nearly constant, and ample for prompt response to the driver's needs. Above 55 miles per hour the reserve power falls off rapidly to the maximum speed of 63 miles per hour where the reserve is zero.

Fuel consumption can be measured quite conveniently on the chassis dynamometer. Fuel economy of a motor car can be stated in different units, but is usually expressed in pounds of fuel used per hour for one horsepower. Measured on this basis, all engines are on a par, with minor differences produced by the com-

pression ratio, carburetor setting, and internal friction.

This economy unit is often called the "fuel rate" and its best value is about 0.5 of a pound per horsepower for gasoline engines. This value can be reached, however, only when the engine is tuned up for full-power operation, as in airplanes. Motor-car engines must perform smoothly at all speeds, must start and idle well, requirements that can be met only by a richer fuel mixture. In consequence, the fuel rate of automobile engines is barely lower than 0.70 to 0.80 of a pound per horsepower at wide-open throttle—that is, for the steepest grade that can be climbed. At part throttle, the fuel rate is considerably increased, and may reach values as large as 1.5 to 2.0 pounds per horsepower hour at very light loads.

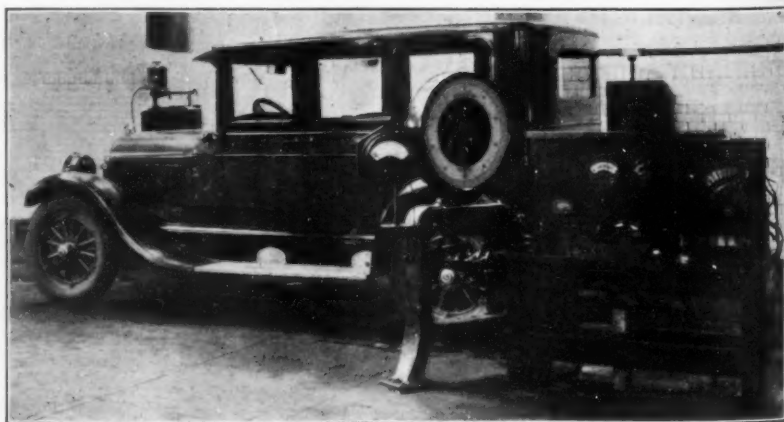
Another measure of fuel economy is the number of miles that can be traveled on one gallon of fuel. This

unit varies in magnitude with the car speed and with the grade, and values are usually stated for level and for steepest grade that can be climbed at each speed. Weight is an important factor in this unit, and the light car has the better economy, as is quite evident. For example, a motor cycle may travel 60 miles per gallon on level road, while a loaded truck may go but one twelfth of this distance—hence the fuel cost of running the truck is twelve times as much as that of the smaller and lighter vehicle.

THE miles per gallon may be determined on the chassis dynamometer by converting the fuel consumption into gallons per hour, and dividing the miles per hour by the gallons per hour. The actual miles per gallon for long trips on good roads should lie between 22 miles per gallon at light load to 5.5 miles per gallon at full load when running 10 miles per hour. At 50 miles per hour, the mileage is 15.3 versus 8.3 under the same conditions.

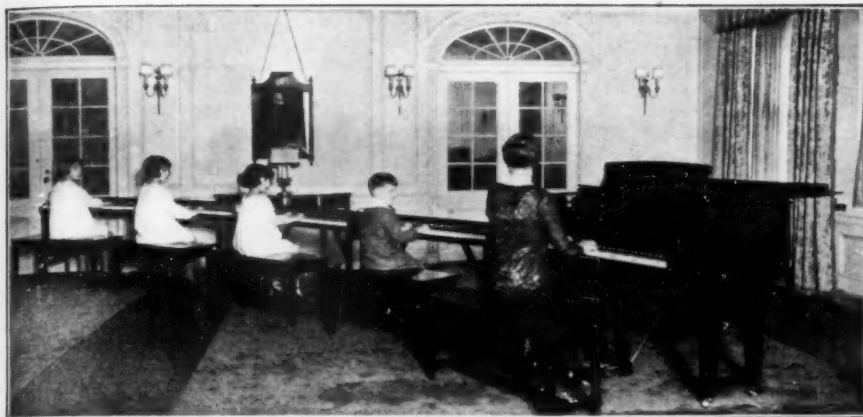
Experience shows that the miles per gallon obtained on improved roads, checks closely with the level road figure from the dynamometer test. This indicates that the up grades are offset by the down grades as far as fuel consumption is concerned, giving practically the same fuel consumption as on level road on a long trip.

Simultaneous count of revolutions of rear wheels and traction drums shows that tire slip is practically absent on a dry surface. On the other hand, there is a small but measurable creep of the tire due to the stretch of the rubber at the point of contact with the road. Due to this creeping action, the driving tires tend to gain speed when power is applied, and to lose speed when brakes are applied, resulting, practically, in zero displacement, since one creep offsets the other.



THE DYNAMOMETER TEST

FIGURE 4: With the rear wheels resting on the traction drums shown in Figure 1, many factors including frictional losses in tires and transmission can be found



PIANO CLASS TEACHING

The illustration shows a children's class being taught by the "Visiola." As the teacher depresses a group of keys, little lights flash up over the pupil's keyboards, showing the location of the note, its duration, sequence, fingering, and phrasing. The interpretation so unified appeals to the children, all of whom receive the lesson simultaneously. The pupils are interested and get the swing of the mechanics of music without the necessity of drudgery.

DEMONSTRATION STAGE

A large keyboard was installed so that the audience could follow the progress of the lesson. The teacher sat at the piano on the right and "dictated," by means of the little lamps, to the pupil on her left, who in turn flashed the notes on the great keyboard so that the audience could see the action. The notation was shown on a screen at the left. After ten minutes of instruction, the child alone played the piece that had just been learned "by electricity."



TRANSMITTING MECHANISM

Plungers rest on each key so that contact is made when keys are depressed



BULBS ON KEYBOARD

As the key is depressed, the same note on the pupil's keyboard flashes



LIGHTS SHOW NOTES

While keys flash white, black keys flash red on the pupil's "lightboard"

Piano Instruction Aided Electrically

In the reading of piano music, there are a great number of facts that pertain merely to such mechanics as the names of notes, names of keys, lines, spaces, sharps, flats, tempos, expression marks, signatures, accidentals, et cetera. To play the simplest tune, the beginner must learn the names of the keys; the names of the notes; the values of the notes; the correct fingering of each hand; the use of the hands on the proper keys; to keep thought on the proper use of hands and body, and to correlate all of these. The approach to music through the door of the printed page cannot, therefore, lead the beginner deftly, swiftly, interestingly and with logical sequence into the heart of the playing of music, because it takes time to master the intricacies of musical grammar.

Electrical science now for the first time enters the field of the art of teaching music and by means of the device illustrated, combines, translates, reduces and simplifies the six separate processes indicated by notation—the sign language of music as indicated on the printed page—into one easily understandable picture, thus coordinating the three senses of sight, hearing and touch. This device leads the beginner at once into the joy and beauty of music. Thus acquired, the immediate ability to play thrills the beginner with the joy of his own accomplishment. The value of this system as a developer of concentration has been recognized by many of the leading educators of the world. Anything which will take the drudgery out of learning to play, is certainly a great boon.



All Illustrations by the Author

FIGURE 1

This is a perspective view, supposedly taken from a park looking towards a street intersection in a part of the city where the plan proposed in the following article has been carried out. Here is seen the automobile runway on the axis of the avenue, the elevated sidewalks bridged across the streets, et cetera.

Buildings of the type which would naturally result from the single offset are also indicated. The ugly effects produced by the present building regulations are gone, and in their places are beautifully designed buildings. Even the finely tapering towers do not detract from the sense of ruggedness of the structures.

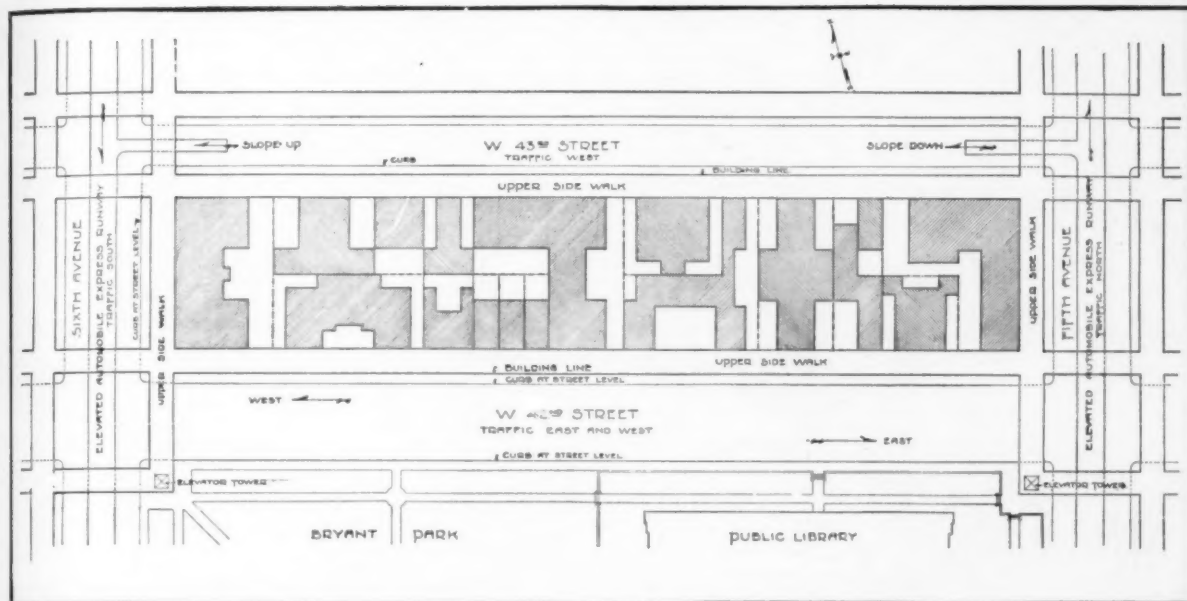


FIGURE 2

In this plan a city block 200 by 900 feet is divided into a number of typical plots on which the buildings are arranged in accordance with the proposed restrictions of area. The plan is supposed to be taken above the elevated sidewalks, and it should be remembered that below them there would be two

stories in the buildings, for the outer edge of the sidewalks is on the property line and the inner edge at the offset line. Within the offset line on each plot, one third of the area is shown as vacant, but the proposed regulations provide that tight areas are obligatory only above the fourth story of buildings

The City of the Future---II

Revision of Building Regulations Would Increase Greatly the Utility of Large Buildings

By ERNEST FLAGG

IN the last article it was explained how traffic facilities might be increased three-fold, which is evidently necessary if cities are to be three times their former height or bulk.

Many imaginary plans have been made for cities of the future. It is easy to do that, but not easy to make a plan that is practicable. In order to do so there are many elements to be considered. Traffic, light, zoning and the consequent restrictions on height and bulk of buildings are factors so interdependent that all must be taken together in any practicable plan. The one here presented deals with all these things, yet it is so simple that it may be stated in a few paragraphs. Here it is:

Regulations for Height and Bulk of Buildings and Zoning for Use

First: Buildings restricted at building line and for 25 feet back therefrom to a height of two stories. One third of the rest of the plot to four stories and the remainder unrestricted as to height.

Second: Buildings over four stories high in any part thereof not to contain in their construction

more wood than an average of one foot board measure to each two square feet of floor space.

Third: No room to be used for dwelling purposes in which a line drawn from the floor through the window at right angles to the wall to the clear sky falls on the floor at less than one tenth of the depth of the room from said wall. Also except at street fronts said line not to cross the line of the plot at a height of less than 50 feet above the street curb.

Fourth: Amended definitions: A tenement house is one in which three or more families cook on the premises and which has no passenger elevator service to every apartment above the ground floor. An apartment house is one in which three or more families cook on the premises and in which there is passenger elevator service to every apartment above the ground floor. A tarry house is any building over four stories high, used as a club, hotel, lodging, boarding or bath house.

Fifth: The present zoning map to be sub-divided into a great number of small sub-districts, the dividing lines to run where possible

through the center of blocks so that both sides of street may have similar treatment, and these subdivisions classified in accordance with the new definitions. Tenement houses, apartment houses and tarry houses to be permitted in all districts except those reserved for dwelling houses, but clubs, boarding, lodging and bath houses not over four stories high may be in any district.

Sixth: A change of designation to be granted when 60 percent of the owners representing 80 percent of the assessed value of the land in any sub-district petition for it.

This is all there is and all that is necessary. Unnecessary restrictions on property and liberty should not be tolerated.

THIS plan would correct a present flagrant injustice in taxation. As matters now stand, if a person owns a building of moderate height in the neighborhood of high buildings, the assessed value of the land is influenced by the earning power of the other buildings. Therefore, unless the owner

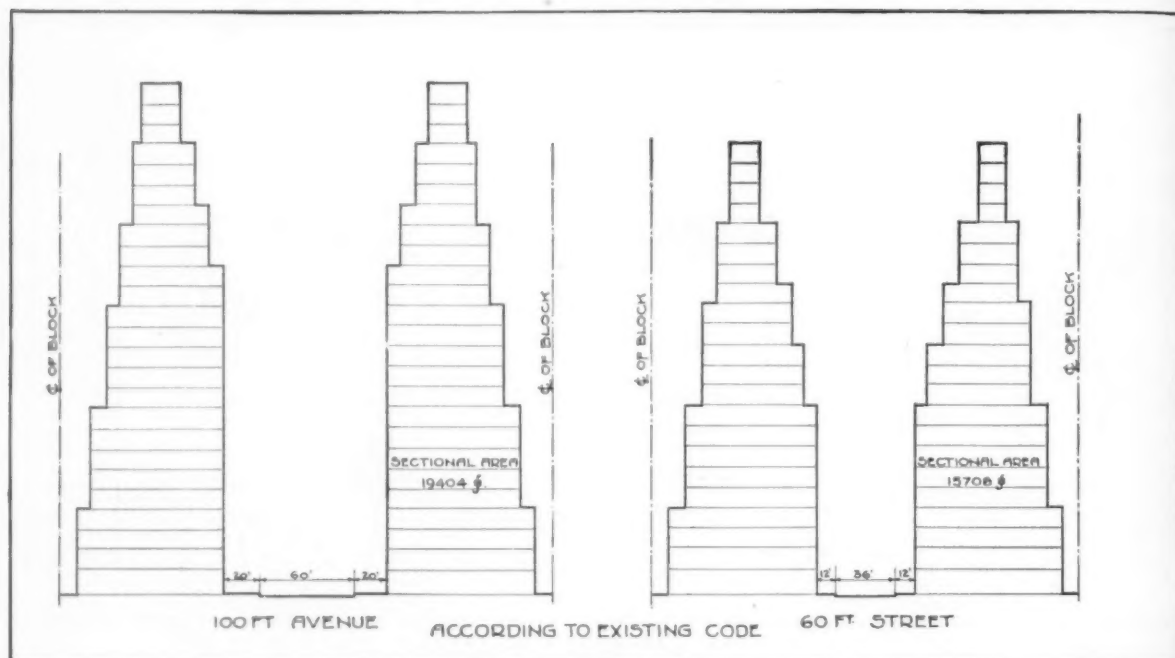


FIGURE 3

Here are represented cross sections through buildings as governed by the present New York regulations; at the left through an avenue or street 100 feet

wide and to the right through a street 60 feet wide. In practice, these offsets tend to produce buildings of excessive ugliness as is now quite evident to all

builds to a great height and adds to the general congestion, he is likely to see the whole income from his property virtually confiscated by the city in taxes. By the proposed plan, this would be automatically corrected, especially as regards small plots. If the city limits the area which can be built upon in such a way as to prevent building, or to make high buildings unprofitable, that fact must be considered in assessing land value. If the tax is so reduced that the property can earn a fair return on its value, what has the owner to complain of?

Zoning for use would be by far the easiest part of the problem, provided common sense were allowed to operate. At present the matter is complicated beyond belief. In New York it occupies the larger part of the time of the Board of Estimate and Apportionment and otherwise causes more trouble and friction than any other part of the civic machinery. City officials and others acquainted with its working say it leads to constant irritation, injustice, complaint and trouble.

Zoning for use has for its object the establishment of a reasonable degree of permanency in the various neighborhoods. It is done for the benefit of those neighborhoods, and there should be no desire to continue regulations after they have become distasteful to the great majority in whose interests they were made.

The present classification in New York is very defective in that it places single-family houses, tall apart-

ment houses, hotels, et cetera, all in one category, whereas buildings of these different types often hurt each other when in juxtaposition. The proposed plan therefore provides for four definitions instead of two as at present. If zoning were placed on this basis it would work automatically, and districts improperly zoned at present would soon correct themselves.

We have now sketched in outline the whole plan, but no plan is worth consideration unless it can be shown to be practicable. Any plan of so far-reaching a nature as this is only practicable when backed by public opinion. The public must be convinced of the necessity for it.

LET us briefly consider the three classes of objections likely to be made to this or any other plan having similar objects:

First: Financial difficulties. The cost would be great, but the same objection would apply to any plan and probably not more so to this than to another of even less efficiency. For instance, if it was proposed to triple the width of the streets, the cost would be too great for even a moment's consideration.

Some of the most important parts of the plan can be carried out at little or no cost. The city now has the power to make offsets in buildings and if at one height why not at another? It also has power to establish new building lines. In requiring an offset at the top of the second story it would accomplish what would other-

wise be the most costly part of the plan, at no expense whatever, that is, the widening of the streets. Moreover the property holder in most cases would not go unrewarded, for by the increased street width he would obtain much better light for his building and by the elevated sidewalk, greatly increased value of the floor at its level.

Figure 1 shows the type of building which would naturally result from the proposed regulations. It also shows stores at the upper sidewalk level. At present, the required offsets represent nothing but loss and ugliness, whereas offsets of the kind proposed would represent beauty and profit.

Figure 2 shows how buildings might be arranged on a typical New York block of 200 by 900 feet under the proposed regulations. The plots are also typical of those usually found in New York as to size and shape. An offset 25 feet wide has been taken off on all sides of the block above the second story to provide elevated sidewalks. Below this level, floors extend to the present building line. Back of the offset the high parts of the buildings, cross-hatched on the drawing, occupy two-thirds of what remains of the plot, the rest being limited to four stories, the proper lighting of which could safely be left to owners. It will be seen from this that those parts of buildings not directly lighted from the street could for the most part be lighted from courts or recesses from the street.

Figure 3 shows the present New

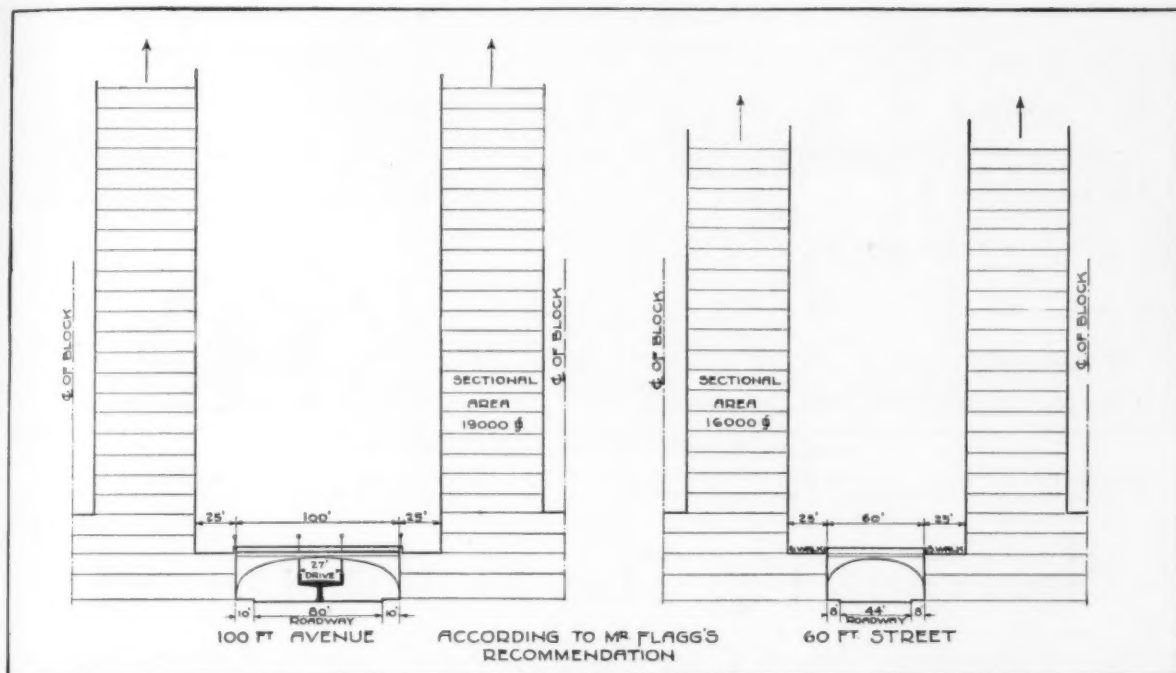


FIGURE 4

Sections similar to those in Figure 3, but under the proposed regulations. It will be seen that whereas the offset here required adds vastly to the value of

the street for light, allows of the necessary separation of pedestrian traffic, and affords another floor for shops, yet the bulk of buildings is not reduced

York regulations as to offsets in principal business districts, for avenues one hundred feet wide and streets sixty feet wide. The result of these offsets is buildings often of excruciating ugliness.

Figure 4 illustrates the single offset under the proposed plan. As both Figures 2 and 3 represent sections of buildings supposed to be of the full width of the plot, the area of the section as indicated on the drawings is proportionate to the area of the floors, from which it appears that no diminution is intended. Moreover, as the height is unlimited under the proposed plan and is limited under the present plan, more floor area may be had if wanted. It is proposed to let economic considerations limit height.

Second: Legal difficulties: Here again similar difficulties would be met in carrying out any plan and perhaps not as much in this one as in another. It would clash with the building and tenement laws and maybe with others, but if wanted by the public, these obstacles could be overcome. If under this proposed plan construction can proceed on the present scale, which otherwise must soon cease, it is not likely that any existing laws can prevail against it. They could be amended or repealed.

Third: Sentimental Objections: To overcome these for any plan will require a campaign of education. People must be convinced both of the practicability and desirability of the plan and that their fears are groundless.

For instance, many will object to the elevated runways; they will say we have tried elevated roads and want no more of them—they ruin streets.

It is not however the elevated railways which are so objectionable, but their supports. Two rows of posts spoil a street but a single row on the axis of the roadway would do no harm. Other similar objections will disappear when the truth is understood. Many will think that the plan will take too long to carry out, but a similar objection would apply equally to any other plan. A hundred years in the life of a city is perhaps not as much as a single year in the life of an individual. Time, therefore, need not be much considered.

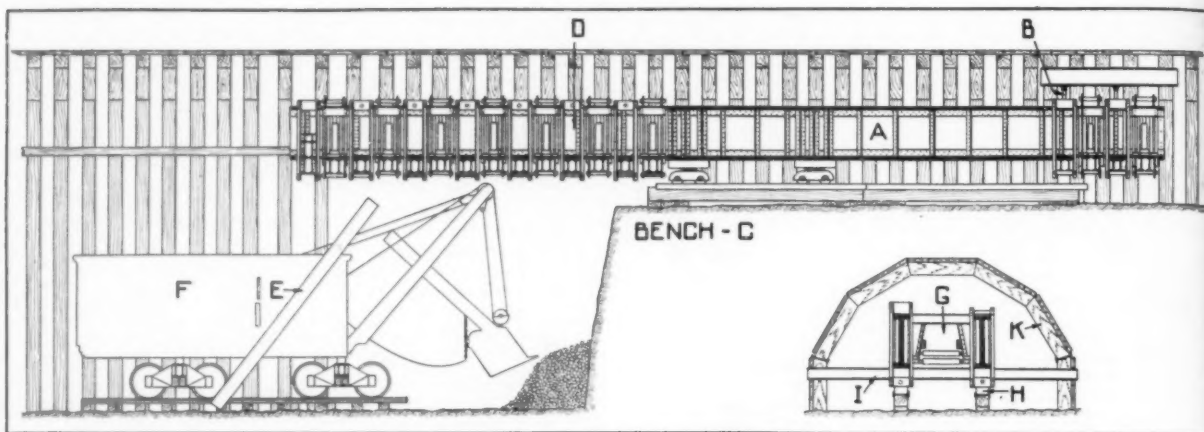
ONE great advantage of this plan is that it could be carried out gradually. Section after section could be added as building proceeds and as time passed, the way would always become easier because all new buildings would be prepared to receive it. The greatest difficulties would be in the old buildings which would have to adapt themselves to the elevated sidewalks. To rearrange cities is an operation requiring patience, though when once begun change often takes place faster than would seem possible.

Many years ago when a pupil at the *Ecole des Beaux Arts* in Paris, I worked in a studio in an interesting old building on the *rue du Four*, or street of the oven. The roadway of this street was hardly more than sufficient for

two vehicles to pass and the sidewalks in general were very narrow, although here and there a house set back a considerable distance from the curb. On asking the reason for this, I was told that about 100 years before, new lines had been established for the street and everyone who built since had been obliged to conform to them. Moreover, that it was forbidden to make repairs in the old buildings beyond a certain percentage of their value. When I visited Paris two or three years ago, I set out to revisit my old haunts. Upon reaching the place where the *rue du Four* ought to have been, I saw nothing that resembled it. In its stead was a broad modern street with fine shops. I could not believe I was in the right place until I read the name at the corner. Such is the result of that kind of forethought which has made Paris what it is and which if applied here can make New York what it should be.

One thing is certain. We are not proceeding in the right direction now and the further we go from it the harder it will be to retrace our steps. Although the plan here outlined has been described with special reference to New York, its principles are equally adaptable to any other city.

The first one to adopt it would be pre-eminent as the first truly modern city—the one in which changed conditions brought about by steel-frame buildings, elevators and automobiles, have been faced and adequately dealt with, both for the present and future.



MASSIVE, TIME-SAVING, CANTILEVER BEAM

Cantilever rests on trucks, running on a track on the floor of the bench (the upper half of the excavation). A belt conveyor within the

beam carries the spoil back to the "muck" cars. The cantilever also supports roof timbers until wall plumb posts are set in place

Speeding Up The Moffat Tunnel

New Cantilever Beam Cuts Time in Half, Saves Labor Costs, and Prevents Disastrous Slides

THE driving of Moffat Tunnel, which is over six miles in length, through James Peak in Colorado, takes rank among the major tunnel operations of the present day. Apart from its size, the tunnel carries a special interest not only for the reason that its methods of construction embody the experience which has been gained in previous work of this character, but because use was made of an entirely new method of excavation, which was developed to meet the difficult conditions which confronted the engineers—difficulties due to the uncertain character of the material and the tendency of the side walls to move in on the tunnel during construction.

In driving tunnels of large size, the upper portion is excavated first, and then the lower half, known as the "bench," is removed. Both operations are carried on simultaneously, the face of the upper section being always a certain distance ahead of the face of the bench. As the upper half is taken out, it is timbered—this timber being supported upon the bench below. Then as the bench is taken out, plumb posts are put in place reaching from the longitudinal wall plate upon which the roof timbers rest, down to the floor of the tunnel.

TO meet the need of quicker and cheaper bench excavation in soft ground, as well as to provide a means of holding the wall plates and ribs in their original position during the operations of excavating the bench

and placing the plumb posts in place, a problem frequently confronting the tunnel engineer, George Lewis, General Manager for the Moffat Tunnel Commission, designed a new device which operated successfully at a great saving both in time and costs at the western end of the tunnel.

In driving the tunnel, a method similar to what is known as the "twin headings" was used. The main 16-foot by 24-foot railroad tunnel was paralleled by an eight-foot by eight-foot water tunnel, located 75 feet south of the main tunnel. This latter tunnel served the purpose of carrying water under the Continental Divide from the

western to the eastern mountain slope.

The water tunnel was excavated more rapidly than the main headings of the railroad tunnel, and at convenient distances, usually 1500 feet, cross-cuts were driven from the water tunnel to the line of the railroad tunnel, thus furnishing many points of attack for driving in both directions along the line of the main tunnel. At the west portal, the main headings were driven approximately eight feet by ten feet in section. The top of these headings coincides with the line of the top of the railroad tunnel. This operation was followed by widening to the full width required for the railroad tunnel; after which the wall plates, ribs and laggings were placed. The ribs were thoroughly blocked up at each joint, and all open spaces between the lagging and the surrounding rock were filled with either rock or cordwood packing. After this work was completed, there remained to be excavated a bench 16 feet in height.



TUNNEL WORKING FORCE

Heavy inflow of water during the driving of the tunnel made oilskins necessary

THE predominating rocks are schists and gneisses. The constituent minerals are largely biotite, talc and chlorite. All of these are soft and structurally weak. The formation is broken by faults and fractures—many of the strata being liable to slip when excavation is being carried on. Where this rock is saturated with water, it frequently runs so freely that hay, et cetera is required to check its flow.

Prior to the installation of the Lewis cantilever beam, two different methods were used in supporting the wall plates

and the roof during excavation of the bench below. The first was by the use of rakers or inclined temporary posts, reaching from the wall plates to the top of the bench. These were removed as soon as the long permanent posts of the finished tunnel were set. This method however, interfered with the removal of the excavated material; moreover, it failed to hold the wall plates in place.

Then what is known as the "I"-beam system was tried. This consisted of "I"-beams held up by longitudinal girders, which themselves were supported at one end by cross-members bearing on the wall plates of the completed timbering, the other ends resting on the unexcavated bench. This method also failed to hold the wall plates and roof in position and it proved to be clumsy in operation. Neither of the two methods gave satisfaction. The work was cumbersome, slow and costly, and the wall plates and roof would at times settle until they came within the finished dimensions of the tunnel. Furthermore, in places, the bench was so soft it had to be taken out in two eight-foot sections; a slow and unsatisfactory process.

THE cantilever beam was designed by Mr. Lewis to overcome the objections present in the systems above mentioned, and to speed up the work. The device consists essentially of two parallel plate girders, three and one-half feet deep, 60 feet long, spaced six feet apart and tied together with the necessary cross frames and bracing. The girder is carried on two pairs of "dollies," or trucks, with ball-and-socket bearings to permit free movement in guiding the girders. The girder trucks roll on a 15-inch "I"-beam track laid on 12-inch by 12-inch stringers. At the rear or overhanging end of the beam and extending horizontally at right angles to it, arms provided with a positive horizontal and vertical movement are sus-



REAR OF CANTILEVER BEAM

This shows shovel taking out the bench. Above is seen rear end of cantilever

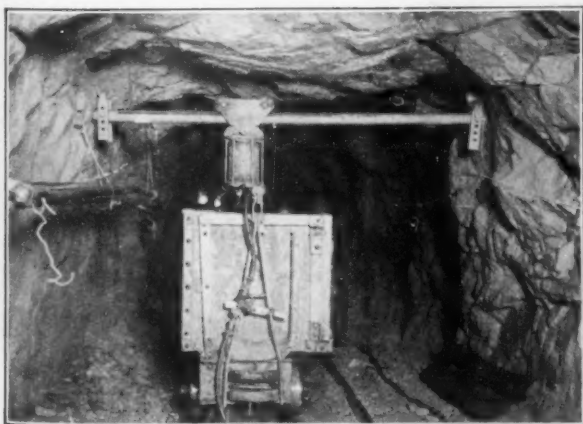
pended as shown in the drawings on the opposite page.

In operation, the cantilever girder is supported on the "I"-beam track which is laid on the top of the bench in the completed top section of the tunnel. At its forward end, the girder is prevented from rising by means of "I" beams and powerful hydraulic jacks which extend from the roof timbers down to the top of the girder. The transverse arms are rolled out under the wall plates from the rear end of the girder and are blocked horizontally—thus preventing the wall plates from moving in under the pressure of the rock. The entire arm is then raised vertically by means of a special steel wedge, which is operated by a rod with a right-and-left-hand thread, until the weight of the wall plates and roof timbers is transferred through the cross girders to the cantilever beam. The bench is then drilled and "shot," the broken rock being removed by a one-yard shovel operated by compressed air, which works under the overhanging end of the cantilever

beam as shown in our illustration. The plumb posts are then raised into place by a compressed-air hoist.

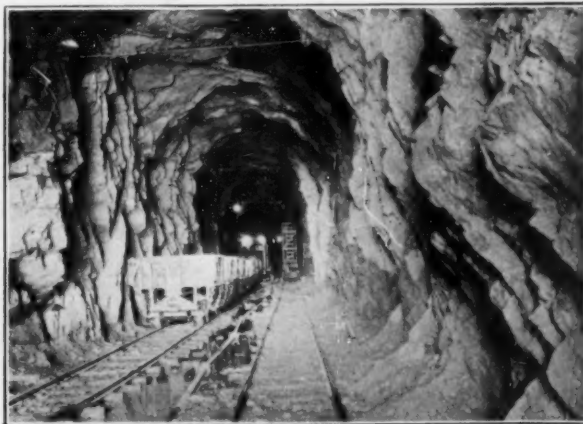
The speeding up of the work due to this device was remarkable. Under the old "I"-beam system, it was not considered safe to remove more than six feet of bench at one operation, but by the use of the cantilever beam, 17 feet were "shot" and the mucking operations were carried on with ease and speed. Thus, in one cycle of operations, a section of bench 17 feet in length was removed and the permanent plumb posts set in place. The cantilever beam was then pulled forward on its track by the use of another air hoist mounted on the forward end of the machine. The time required for one cycle of operations was reduced from 24 to 18 hours and less as the work gang gained experience. It is estimated that by the time the tunnel is completed, this device will have saved the Tunnel Commission over 2,500,000 dollars in labor costs alone.

THE vastness of the project can be comprehended when it is considered that the estimates place the total rock excavation at 522,500 cubic yards. To excavate and handle this great volume of material, men working in eight-hour shifts are on the job day and night. Electricity for lighting and power purposes is generated at a station on South Boulder Creek. Direct current at 250 volts is supplied for driving the mucking machines, electric locomotives, blowers, et cetera. The air for the compressors is delivered to the headings by means of an eight-inch line that is carried through the water tunnel. Thence, smaller piping conveys the compressed air through the crosscuts to the points where it is required. Since fresh air is essential for the men working at this altitude, a ventilating plant was set up at each portal, capable of delivering about 25,000 feet of fresh air per minute to the various headings.



ONE OF THE MUCK CARS

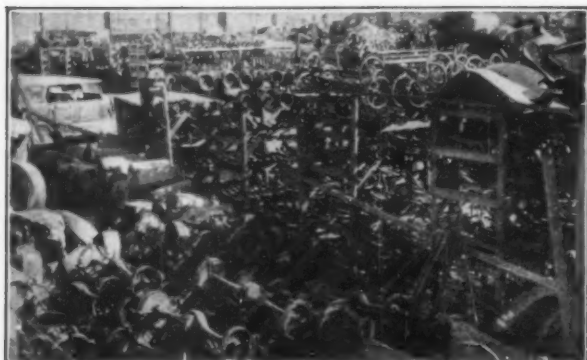
Air hoist, running on transverse bar, lifts muck cars and transfers them to and from the tracks. This proved a time-saver



THE EXCAVATED TUNNEL

This view shows part of the excavated tunnel where it ran through solid granite. Note the two tracks and the muck cars

From the Scrap-book of Science—



Wide World

WHERE YOUR USED CAR GOES

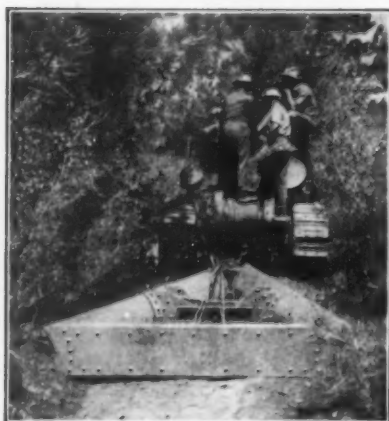
Here is one corner of a used-car bone-yard in Los Angeles. Scrapping worn out and wrecked cars has become an important industry. Everything is classified and practically nothing is wasted. Many parts are used again



Wide World

HORSE SHOES ARE ALSO SCRAPPED

Until quite recently the horse maintained its numbers despite the motor car. Now, however, the horse is decreasing in numbers. Here is a junk pile consisting chiefly of horse shoes, good, now, only for "muck iron"



P and A

TRACTOR MAKES FIREBREAKS

In California, tractor drawn equipment of this kind is used for making firebreaks in the brush. It does much more work than a plow will do

ANCIENT SCIENTISTS COLLECTED FOSSIL

Dr. Barnum Brown, Associate Curator of fossil vertebrates in the American Museum of Natural History, holding in his hands the fossil elephant's molar shown at the right—a most odd and peculiar discovery ▼



Acystone



Acystone

ODD FOSSIL FIND

Tooth of extinct elephant found in ruins of ancient Greek medical school. Did Greeks collect fossils?



P and A

REPAIR VESSEL A "FLOATING NAVY YARD"

The United States naval repair steamer *Medusa* carries in her hold more than a million dollars worth of stores, ranging from material for overhauling a 12,000 horsepower turbine, down to jewels for ship's chronometers. Most of her crew of over 500 are trained craftsmen. In the picture three destroyers are shown undergoing repairs nearby

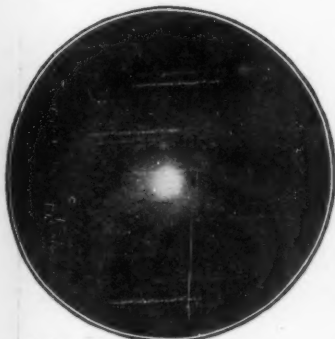


International News Reel

PHOTOELECTRIC CELL BURGLAR ALARM

Dr. Robert L. Burt of the California Institute of Technology, has devised a burglar alarm that is actuated by a light-sensitive photoelectric cell. When the intruder interrupts a beam of light, the cell operates a relay, giving an alarm. Thus an intangible bar of light excludes as surely as a bar of steel. The beam is reflected by mirrors

Camera Shots of Scientific Events



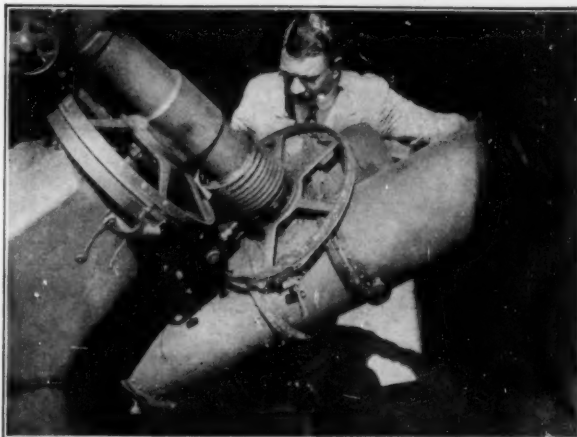
Wide World

THE RECENT COMET

The Pons-Winnecke comet. The telescope was moved with the comet, hence the star-trails that show here

PHOTOGRAPHING THE COMET

Prof. John H. Pitman of Swarthmore College with an astronomical camera with which our recent interplanetary visitor, the Pons-Winnecke comet, was photographed, as shown in the illustration at left. An astronomical photograph is made by inserting a photographic plate in the focal plane of a telescope, in place of the eye, the telescope being slowly moved by a large clock to offset the rotation of the earth



Wide World



Wide World

ORIGINAL "ASBESTOS CAT"

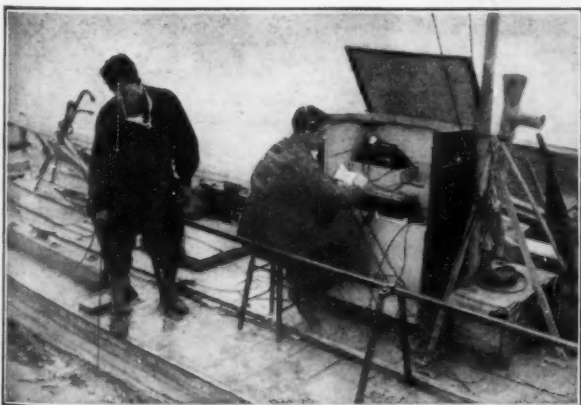
Tex Thornton, clad in an inch-thick suit of asbestos, successfully puts out oil-well fires by exploding T. N. T.



Wide World

PULVERIZED COAL FOR MARINE BOILERS

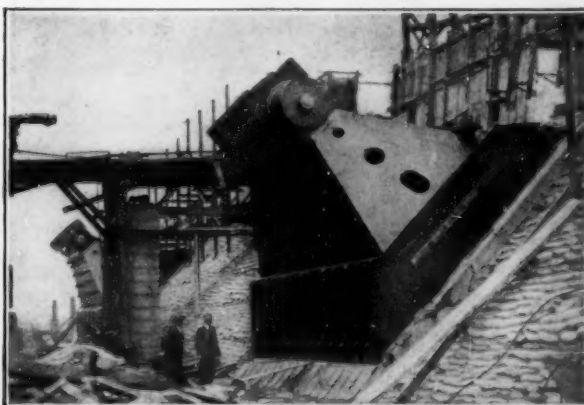
The development of fuel technology has now reached the point where pulverized coal, for several years used in boiler installations on land, is being experimented with on steamships. Photograph shows tests being made at Philadelphia Navy Yard. Greater fuel economy and numerous other advantages will be gained when it is proved practicable to use pulverized fuel on ships



Herbert

CHARTING BED OF NEW YORK HARBOR

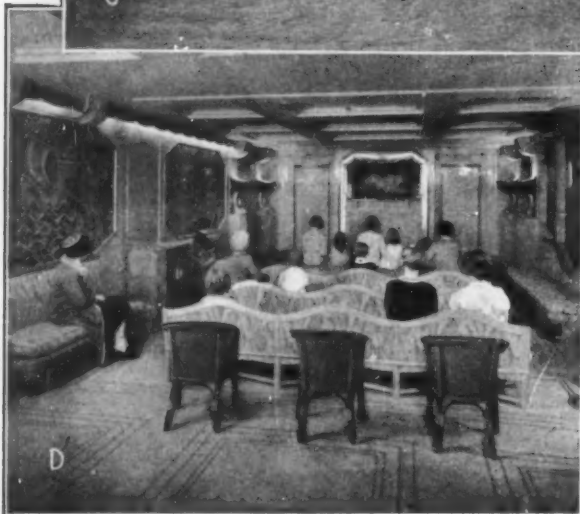
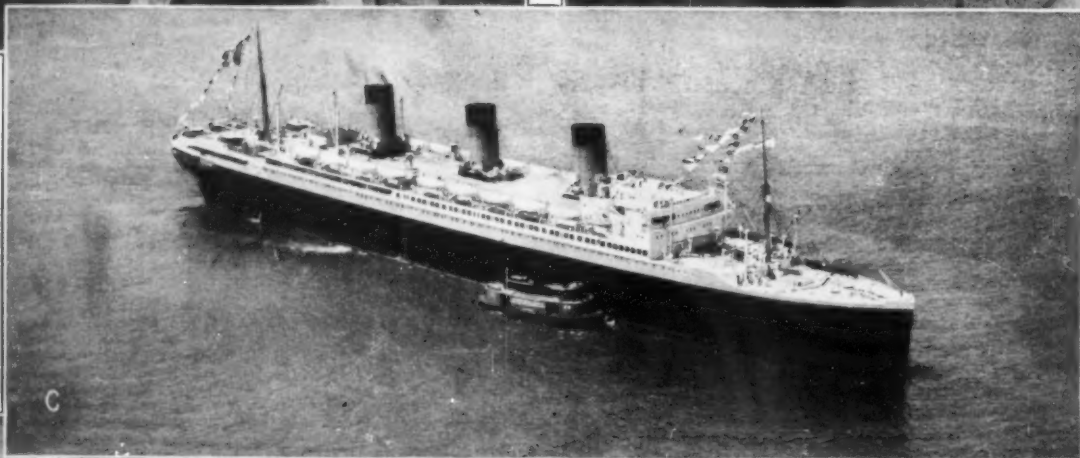
Photograph shows expert leadsmen making systematic soundings from United States Army Engineer Corps barge in New York harbor. The soundings are recorded by a dictophone which is shown in use at the right



Bos Feature Bureau

TO CARRY 50,190,000 POUND THRUST

Two of the main bearings of the great bridge that is about to be thrown across Sydney Harbor in Australia. Each enormous bearing will take a 25,000 ton thrust from the foot of the tremendous steel arch butted against it



Outward Bound on the "Ile de France"

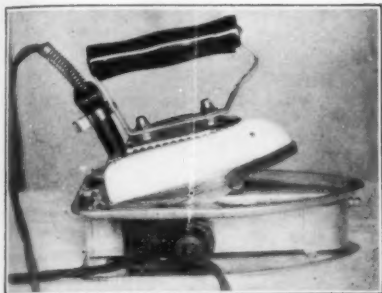
This new example of marine architecture is indeed a masterpiece, and we are only able to show a few of the interesting features, especially those reserved for the young people. The *Ile de France* is the world's sixth largest vessel, being of 43,500 gross tons, 790 feet in length, and 98½ feet beam. The turbines develop 52,000 horsepower and drive the vessel at 23½ knots per hour. Among the interesting features of this great boat is the enormous top deck, which can be used for games of all kinds, including tennis. This is shown in the center illustration, marked C. The grand foyer is four decks high. The features which we have elected to show are largely the accommodations for children, which are often

sadly lacking on ocean steamers. Not so on the *Ile de France*, where the youngsters have a beautiful little dining room of their own, shown in illustration A, with tables and chairs regulated to their size. There is also a gymnasium, including a merry-go-round, shown in photograph B, and a shooting gallery. There is a charming little Punch and Judy theatre, illustrated at D. Those who are religiously inclined, children and grown-ups alike, can go into the chapel, illustrated in E, at any time, where they will find quiet and reverent surroundings for meditation and prayer. The various public rooms are decorated in the most beautiful manner, and the entire vessel is the last word in luxury for trans-ocean travelers.

Household Inventions

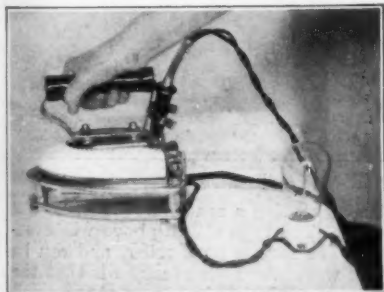
A Department Devoted to Housekeeping Advances

CONDUCTED BY ALBERT A. HOPKINS



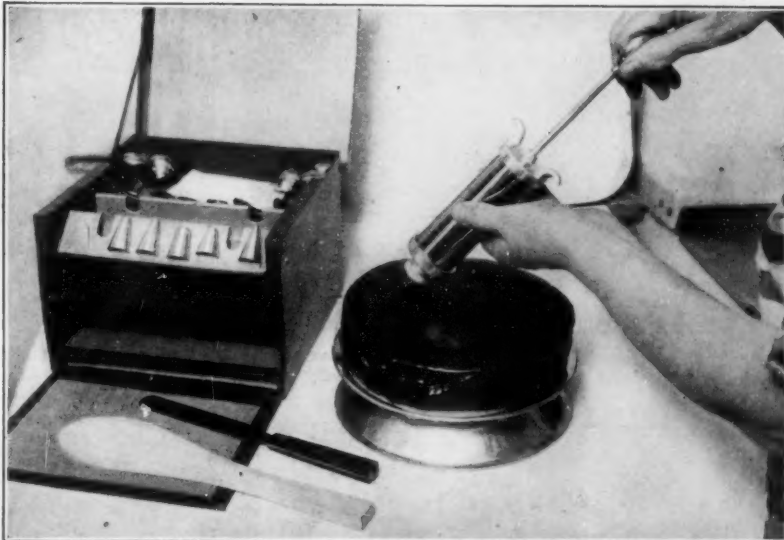
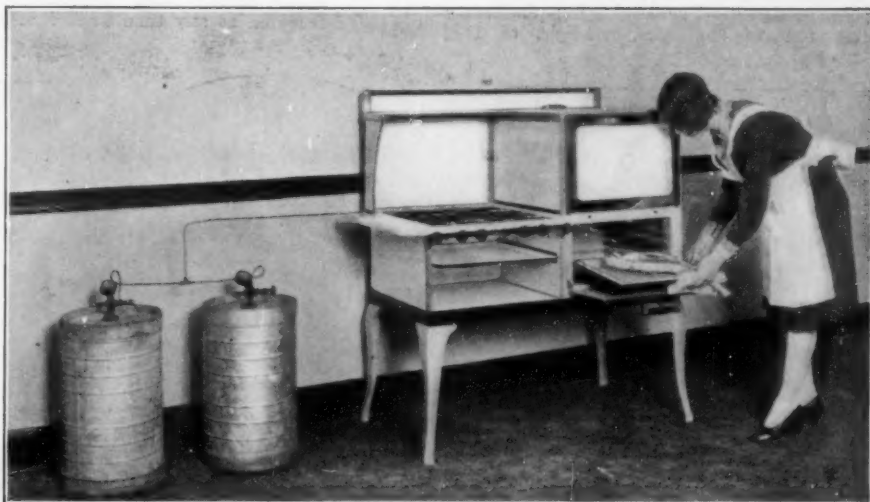
**SAFEGUARDING THE
ELECTRIC IRON** ↑

With the electric-iron holders shown above and below, the fire hazard is greatly minimized. In fact we might almost say that all danger is eliminated, for the stands turn the current on or off according to the degree of heat required to supply the iron with the proper ironing temperature. An electric lamp is introduced into the circuit in one make so as to indicate when the current is on or off. The electric-iron is one of greatest aids to the elimination of drudgery and it is gratifying to see the inventors trying to make it absolutely safe by means of such devices as these ↓



**COOKING WITH BOTTLED
FUMES FROM OIL WELLS**

The vapor that rises from oil wells that are in production and even from wells that have been pumped out is now being bottled and sold as fuel. This vapor is refined and compressed until it becomes a low-pressure liquid, which on being released reassumes its gaseous form and burns in an ordinary gas jet. Casinghead gas is a very rich natural gas. As it is compressed, it is refined and the liquid stored in steel bottles. These bottles are attached to heating appliances by means of pipes or tubes and when the valve of the jet is turned, the pressure of the gas forces it through an air mixer similar to that of any gas range. It burns with an odorless flame →



TURNTABLE FOR CAKE ↑

There has always been more or less trouble in turning a cake around when applying decoration. One outfit as illustrated above supplies a turntable made by mounting a pie plate on a deep-dish plate. The decorating accessories are shown, including the palette knife and wooden paddle. The turntable goes in the bottom of the box



ELECTRICITY POPS CORN →

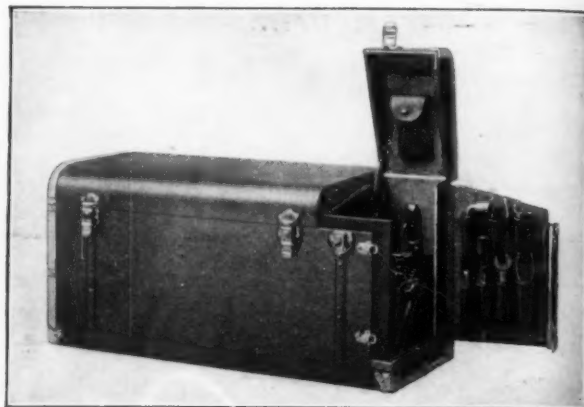
A convenient corn popper that uses electricity for its work is shown at the right. A small crank shown at the left operates an agitator to keep all of the popcorn in motion while it is being popped

Inventions New and Interesting



AUTOMOBILE TRUNK AND TOOL KIT

The handy automobile accessory illustrated above is completely water and dust-proof, and is extremely strong



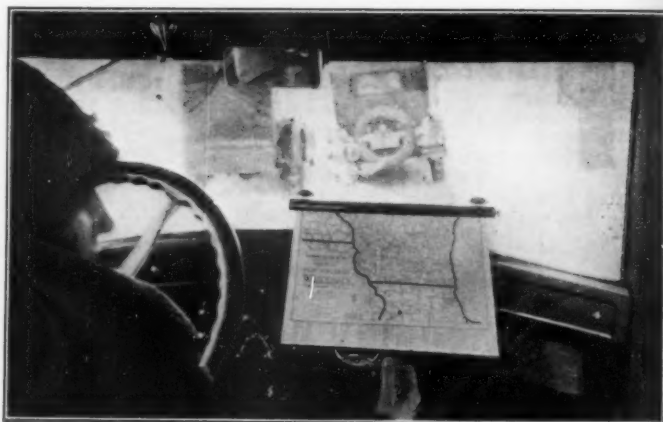
THE TOOL KIT OPEN

In one end of the trunk is space for tools. In the other end, baggage and other traveling necessities can be carried



WOOD-PILING TRUCK

To reduce the time required for loading and unloading lumber trucks, the body illustrated has been designed. The level-rising platform can be elevated to an extreme height of $11\frac{1}{2}$ feet



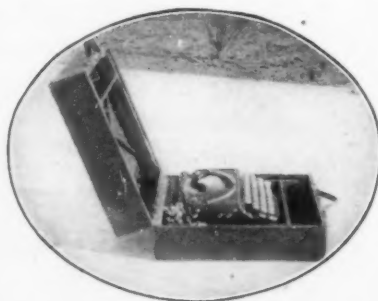
CONVENIENT ROAD MAP

The motorist often has trouble in keeping a road map where it will be readily available for reference. The type shown above will overcome all troubles of this kind. The map is on a roller, and can be rolled up, completely out of the way. An added feature is that the entire device can be attached to any windshield by means of two small rubber suction cups. These afford a firm grip yet the map can be removed at any time when it is desired to substitute another map



TYPEWRITER TABLE

This folding table is also a carrying case for a portable typewriter. Here the table is shown with sides partly folded



READY TO GO

The legs of the table have disappeared within the sides, and the typewriter rests in the space provided for it. Clamps hold the case firmly together



IN WORKING POSITION

The table is held rigid with special braces. There is even a small shelf at one of the sides for papers and the like

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

CONDUCTED BY ALBERT G. INGALLS

The Telescope Making Enthusiasts Convene

WHAT a hobby it must be that will drive forty men to travel hundreds of miles to a common gathering place, just to spend two days and all of one night talking about it! That the SCIENTIFIC AMERICAN's amateur telescope making campaign, begun 18 months ago, is not losing vigor was clearly demonstrated recently when that number of amateurs traveled from several of the eastern states to meet at "Stellafane," Springfield, Vermont, the Mecca of the telescope makers, in order to be present at the second annual convention of this exalted order of astronomical enthusiasts.

"A hobby eminently satisfying and satisfactory," seems to be the verdict after a year and a half of trial of amateur telescope making. "It gets to be almost a disease," some confess; while one man writes that "it has all but ruined my business"—he says he has been unable to lay aside this fascinating work long enough to make a living! We regret that we should have hurt anyone's business by keeping his mind on a hobby, but we confess that there has been quite a little fun and satisfaction in giving such a hobby to 2000 people.

Telescope makers from one end of the country to another, and from Alaska to South America, Japan to South Africa, write us enthusiastic letters, inquiries, requests for advice and assistance and send us photographs of the telescopes they have made. And within the past year or so, hundreds of our readers, working from the SCIENTIFIC AMERICAN instruction book, "Amateur Telescope Making," have completed their reflecting telescopes. A number have already made a second telescope, a few have reached their third, while one—possibly the king enthusiast of all, a Toronto real estate broker—has made four and is still at it with fanatic devotion.



Amateur telescope makers came to Vermont from far and wide. Some brought their families and camped out on the mountain near "Stellafane," which shows in the background. Not a few lady astronomers were present

The man who has not acquired some sort of hobby by the time he is ready to retire from active work should possibly take gas. The best hobby is the one you like the best, no matter what the other fellow thinks about it. A hobby is not supposed to "pay," and must not be justified in any similar way—it just "is." Once he has contracted the telescope "bug," an amateur telescope maker will spend hours and hours pottering in his shop, doing things that admittedly do not pay.

For those of our readers who were not "in" on the first round of our amateur telescope making campaign, a little sketch of this interesting movement might not prove amiss. Two years or so ago one of our

sub-editors became interested in this work and soon found that a group of men in Springfield, Vermont, had already made a hobby of it, forming there a club known as "The Telescope Makers of Springfield." With the help of Mr. Russell W. Porter, leader of that group, a "passable" telescope was completed.

"Why not introduce the readers of the SCIENTIFIC AMERICAN to this interesting work?" This thought became uppermost and was presented to the editor for action. This being decided on, an instruction book was prepared, no suitable book being then available. The price of the book was purposely kept down to two dollars because it was realized that many would not wish to spend a great deal of money on the new hobby. The first printing of "Amateur Telescope Making" has now been pretty well disposed of, indicating that the hobby has taken strong hold on our readers who, as we correctly surmised, wish to do some kind of dignified amateur scientific work having real educational value and perhaps requiring more patience and intelligence than the elementary constructional work sometimes described in mechanical journals.

If a man is reasonably handy with his hands—say, if he can tinker his own car or make a fairly respectable radio set—and can scare up about 30 dollars for materials, he can expect to make a reflecting telescope capable of magnifying 50 to 100 diameters. Such an instrument is not a toy, and even if sometimes crude in external appearance—a thing which does not matter if the essential qualities are present—it will still make visible the rings of Saturn, the belts of Jupiter and four of its satellites, the crescent phases of Venus and no end of double stars and nebulae. This is just what those who came to the second



Astronomical enthusiasts "talking it over" in little groups gathered around two home-made reflecting telescopes. In the background, Mt. Ascutney



Finding the planet Venus in mid-afternoon of a dazzling, sunny day. Although difficult to find, and easy to lose again, when seen it is striking

annual convention of amateur telescope enthusiasts at Stellafane, Springfield, Vermont, have already done.

A gathering of this sort ordinarily starts off with a bean feast. A pot of beans is placed in a hole in the earth which has previously been occupied by a fire. In the meantime the amateurs are busy making one another's acquaintance and "gamming" about telescope making.

Someone discovered Venus. This was at four o'clock in a bright sunny summer's afternoon, the sun being about 45 degrees away from that planet. There are still many who doubt whether Venus is visible in full daylight. Once it has been located, however, no doubts ever linger. Venus is as sharp and clear as the moon, only far smaller. The difficulty is to find it, for the sensitive spot of the retina of the eye takes in only a small angle. Once Venus is found, it should be tied in with some kind of marker, like two upright sticks, for it may otherwise be lost.

The night at Stellafane was spent in observation and informal discussion. Saturn hove into view in due time, then Jupiter and finally a deep bank of cloud. But the enthusiasts were more interested in talking about telescope making—for the stars they have at home, fellow enthusiasts they do not.

Mr. A. W. Everest of the Pittsfield, Massachusetts, Laboratory of the General Electric Company, contributed the interesting information that he had discovered a new substitute for the pitch surface on which the mirror is polished. Honeycomb foundation as supplied to bee keepers is simply cut out and placed over the glass tool commonly used. It makes quick contact, retains the rouge abrasive and brings about much more rapid polishing than the pitch surface.

Mr. Everest has made six mirrors and helped others finish three more. He brought with him a telescope having a single mounting made of two-by-four scantlings and two small cart wheels—altogether a rough looking outfit. But his mirror proved to be practically perfect and the instant service this unlovely telescope gave showed clearly that it is a high grade mirror which constitutes the real heart of a tele-

scope, and that a much-polished, elaborate mounting does not take the place of good optical work.

It is expected that a third "get-together" of amateurs will be held at the same place next year. The invitations will again be sent out to those whose names and addresses are filed in the offices of this magazine, provided they live within reasonable traveling distance of Vermont. And in the meantime the hobby of telescope making will travel a few times more around the world.

The editors have on hand the photographs and descriptions of about six more telescopes made from the SCIENTIFIC AMERICAN instructions. These will be published in turn in the "Editors-Mail" department but it is believed that the majority of instruments that have been made have not yet been photographed.

Record Size Dome Built in America

AMERICAN architects and builders of the twentieth century have gone their ancient brother craftsmen who designed the noble proportions of St. Peter's Cathedral at Rome one step better in the art of dome construction.

St. Peter's, founded in 1480, is still the world's largest cathedral. However, at West Baden, Indiana, a resort hotel has

been built whose immense dome is 212 feet across—12 feet greater than that of the old cathedral, thus making it the largest in the world. A photograph of this structure is reproduced in these columns.

A difficult problem facing the engineers was to design supports of adequate strength to carry the enormous weight of the dome. As completed it rests on 16 solid brick piers laid up in lime mortar. In this respect the new structure is fashioned in the same manner as its ancient rival. The mortar used was a superior modern product but the basic element—lime—was the same as that used by the 15th century masons. This is because of its ability to absorb carbon-dioxide gas from the air and unite with the sand grains and bricks to form a pure limestone and thus bind the masonry into an imperishable mass.

Polarized Light Found to Affect Life

A NEW and hitherto unsuspected influence of the quality of light upon vital processes was announced to the American Chemical Society at its annual meeting held in Richmond, Virginia, by Dr. David I. Macht of the Johns Hopkins University. It is well known that a difference in the wavelength of light, that is, the frequency of vibration, makes a marked difference in its action on plants and animals; that, for instance, rickets may be cured by light of high frequency, such as the ultra-violet rays. Now Dr. Macht has found that the direction of the vibrations also makes a difference in its effects. If the vibrations all lie in the same plane, like a wavy line on a sheet of paper, the action is different than if the vibrations occur in all directions promiscuously as in ordinary light. This peculiar form of light is called "polarized" because the vibrations have a single direction. But it cannot be distinguished by the eye from ordinary light. Ordinary light, such as sunlight, can be polarized by reflecting from a plate of glass or sheet of tin set a certain angle.

An Englishwoman, Miss Elizabeth Semmens, reported in 1923 that polarized light would promote the conversion of starch into sugar. Dr. Macht has confirmed this and gone much farther. Rays of polarized light are found by him to stimulate the growth of yeast and bacteria. Sprouting beans and sunflower seeds grow more rapidly under polarized light than under common light of the same brightness. Certain drugs,



A resort hotel recently built in Indiana has a dome of concrete, 212 feet in diameter. This is the largest reinforced concrete dome in the world



To navigate drifts it is at times necessary to equip the trucks with snow plows, as on the truck in the distance.

Trucks to the Frozen North

IN THE trackless heart of the upper Dominion International Speed Trucks are bold explorers. The McInnes Fish Company, Ltd., Edmonton, Alberta, operating the northernmost inland fisheries on the North American continent, takes them into the Great Slave Lake region, in a latitude as far north as Greenland, to fish for whitefish through the ice.

Last winter, in spite of the hardships of heavy snows, with temperatures falling to 55° below zero, the McInnes International Speed

Trucks transported 1,200,000 pounds of fish to headquarters, besides serving the crews of fishermen with a winter hauling of supplies.

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The International line includes the Special Delivery for loads up to $\frac{1}{2}$ -ton; 4 and 6-cylinder Speed Trucks of $1\frac{1}{2}$, 1 $\frac{1}{2}$ and 2-ton sizes; Heavy-Duty Trucks ranging from $2\frac{1}{2}$ to 5-ton sizes; Motor Coaches; and McCormick-Deering Industrial Tractors. Write for folder on Internationals for your business.

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Binghamton, N. Y.	Columbia, S. C.	Evansville, Ind.	Kankakee, Ill.	Nashville, Tenn.	Portland, Me.	Waterloo, Ia.	Waterloo, Ia.
Birmingham, Ala.	Columbus, Ohio	Fargo, N. D.	Kansas City, Mo.	Newark, N. J.	Portland, Ore.	Watertown, N. Y.	Watertown, N. Y.
Boston, Mass.	Council Bluffs, Iowa	Fort Dodge, Iowa	Knoxville, Tenn.	New Haven, Conn.	Providence, R. I.	Winona, Minn.	Winona, Minn.
Brandon, Man.	Dallas, Texas	Fort Wayne, Ind.	Lethbridge, Alta.	New Orleans, La.	Quebec, Que.	Winston-Salem, N.C.	Winston-Salem, N.C.
Brook, N. Y.	Dayton, Ohio	Gary, Ind.	Lexington, Ky.	New York, N. Y.	Richmond, Va.	Yorckton, Sask.	Yorckton, Sask.
Brooklyn, N. Y.	Denver, Colo.	Grand Forks, N. D.	Lincoln, Neb.	No. Battleford, Sask.	Richmond, Va.		
Buffalo, N. Y.	Des Moines, Iowa	Grand Rapids, Mich.	Little Rock, Ark.	Ogdensburg, N. Y.	Rockford, Ill.		
Calro, Ill.	Detroit, Mich.	Green Bay, Wis.	London, Ont.				
			Long Island City, N.Y.				

such as digitalis, cocaine and quinine, lose in their medicinal power on exposure to polarized light.

Still more interesting is the discovery that polarized light causes sick and poisoned rats to succumb more quickly. Injections of santonin or cocaine caused rats exposed to polarized light to be seized with convulsions, and usually die, sooner than those similarly dosed but living in common light.

These discoveries may aid to explain the irregular and uncertain action of drugs and course of diseases which now perplex the doctors. Daylight is often partially polarized by reflection from sea, snow and sky. Moonlight is largely polarized by the reflection of the sunlight from the surface of our satellite. This may suggest to the reader the possibility that some day science may find some grain of truth in the old folklore theories of the influence of moonlight on plant growth and decay.

—Science Service.

A Lazy Man's Method?

SOME people always characterize as a "lazy man's method" any new way of doing a thing which requires less physical exertion than the old method. This, of course, as both parties to the matter well know—although the accusing party never says so—simply means that the onlooker is a little bit envious of the "lazy man's" inventiveness, and permits this envy to take the form of a mild "ragging." Generally, however, the "lazy man's method" is really the intelligent man's method. There is no virtue in working like a mule when a simple subterfuge will as well suffice.

We have seen people making all sorts of exertion to remove stumps, and we have seen easy-going people leave them to rot out only after a lifetime of ploughing around them. With a burner consisting of a cast-iron furnace, two hoods, a long draft pipe, two short draft-pipes and several lengths of ordinary six-inch stove pipe, Mr. S. F. Zysset, an Oregon farmer, recently cleared several acres of large stumps at less than half the cost of the otherwise necessary blasting powder and stump puller. The method employed is a modification of the old "char-pitting" method, sometimes called "coal pitting," which when properly carried out would consume not only the big stump itself but also a large part of the roots below plow depth.

Char-pitting was, however, a hard proc-

The fire once well started, the furnace is removed from the stump. With a good draft on one side and a smoke stack on the other the stump itself is now a stove. All the little air holes are tightly chinked with mud



ess, and therefore few used it. The new method is so simple that anyone may easily apply it.

As shown in the two illustrations reproduced in these columns, a simple furnace with pipes is inserted in the stump. After the fire is going well, the furnace is withdrawn and the stump is chinked up with earth so that it really constitutes the shell of a furnace itself. The charring process continues for several days until the roots are burned out. This equipment is best used on stumps more than two feet in diameter. The larger the stump the better it burns, once it is well started and supplied with a draft and chimney.

One might indulge in an apostrophe of the burning stump shown in one of our illustrations, somewhat as follows: "Old stump, you're mighty big, and mighty strong and stubborn. I could pull you out with perhaps 100,000 pounds of force; or I could dig you out in a week of hard work. But I'm not one of those chaps who think a man is earning his way only when he's as busy as a frantic dog digging out a rabbit hole. So I'm just going to stand around here, leaning on my shovel and smokin' my old pipe while you burn out. And then next month I'll plant potatoes where you, with all your strength, thought you were safe forever. Old stump, you can't stump me."

Seeks Large-Fruited Native Apple Trees

WANTED: Native American crab-apple trees that bear large apples. Prof. N. E. Hansen of South Dakota State College, Brookings, South Dakota, is on the lookout for American crabapple

trees that can not only make the prairie groves and forest edges glorious with pink bloom in the spring, but later on yield fruits fit to eat, which few of them do now. Or, if they will not bear good apples by their unaided selves, Prof. Hansen proposes to cross them with desirable varieties of the European and Asiatic stocks already in cultivation, and thus obtain hybrids good for planting in the cold and semi-arid plains and foothills of the northwest. Get in touch with him if you know of any wild trees of the native species whose fruits might be worth while in his program.

—Science Service.

Will Powdered Coal Challenge Diesel Oil-Engines?

BEFORE long, many sea-going ships are likely to burn pulverized coal for fuel, thus meeting the present challenge of the Diesel heavy-oil engine, according to the results of tests described by C. J. Jefferson, head of the Fuel Conservation Committee of the Merchant Fleet Corporation of the United States Shipping Board, in *Marine Engineering and Shipping Age* (New York). Pulverized fuel—coal ground to powder and blown into the firebox of a boiler by means of air forced from a series of nozzles—has already made giant strides on shore, where it is installed in some of the largest power stations in the world. Mr. Ford, among others, uses it at River Rouge, Michigan.

"Why should the use of pulverized fuel on ship board be developed?" asks Mr. Jefferson. "What are the differences between a power plant at sea and one on the shore that requires this development work? These two questions, in brief, cover the problem that was put up to the Fuel Conservation Committee of the Shipping Board about a year ago.

"Why should pulverized fuel be made sea-going? Because when it has learned sea-going ways and learns how to behave itself in a marine plant, it will then effect economies in the operating costs of our existing vessels of such a magnitude that an auditor's statement can be a real pleasure.

"If the boiler efficiencies obtained with oil can be duplicated, and if this duplication can be accomplished in such a way that the operating problem is no greater than that on the oil burner, and if all of this can be done with a fuel

(Continued on page 363)



The stump burner's equipment, simple and portable. At the right is the furnace, at left is the extra hood and nearer by are some lengths of iron pipe to be used for placing the draft precisely where it is needed



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Flames of Atomic Hydrogen

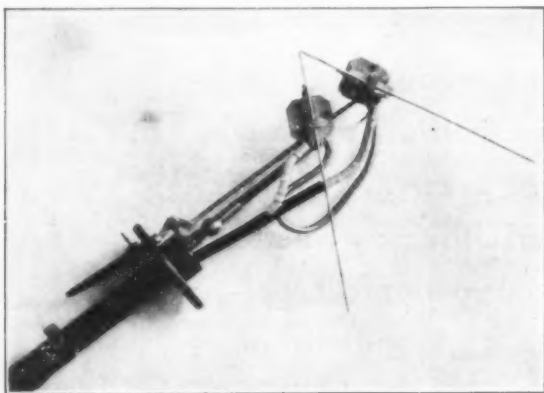
EXPERIMENTS carried out in the laboratory of the General Electric Company by Dr. Irving Langmuir have led to the development of a remarkably efficient welding flame for use in a manner similar to that of oxy-acetylene flames but based instead upon the formation and

Two tungsten rods, as electrodes, are held at a definite angle to one another by easily adjustable clamps, and a jet of hydrogen is directed from a small nozzle along each of these rods near its end. The hydrogen thus bathes the heated parts of the electrodes and forms a gentle blast of gas which passes through the arc between the

six to ten millimeters from the electrodes. Alternating current is generally used.

"The high temperature of this flame, together with its powerful chemical reducing action and the avoidance of gases containing oxygen and nitrogen, renders it particularly useful for welding, not only for iron and its alloys, but for such metals and alloys as contain aluminum, magnesium, chromium, manganese, et cetera."

Samples of metals welded by this means show remarkable ductility. A one sixteenth inch low-carbon steel sheet was welded and then double folded along the line of the weld and double folded a second time at right angles to the first fold without any sign of cracking. A weld in one eighth inch sheet was deeply embossed without any sign of failure. The application of this method to commercial practice seems to offer promise of great value.



Left: One form of the atomic hydrogen welding torch. In this, the two electrodes, held at a fixed angle, are constantly bathed by a stream of hydrogen emanating from a small nozzle near the end of each of the rods

burning of hydrogen in the atomic state. The passage of ordinary hydrogen gas, made up of molecules, each containing two atoms of hydrogen, through an electric arc appears to break it up partially into free atoms of hydrogen. When these atoms of hydrogen are then burned, the temperature produced is sufficient to melt "every refractory material which has been tried, except carbon . . . with comparative ease." Calcium oxide, melting at 2580 degrees, Centigrade; pure magnesium oxide, melting at 2800 degrees, Centigrade; pure thorium oxide melting above 2800 degrees, Centigrade, and numerous other refractories were melted without difficulty. Temperatures above 3200 degrees, Centigrade, were noted on an optical pyrometer.

In reporting his experiments before a recent meeting of the American Chemical Society, Dr. Langmuir described the commercial form of his welding torch as follows:

"The accompanying figure illustrates one of the later forms of torch used for welding.

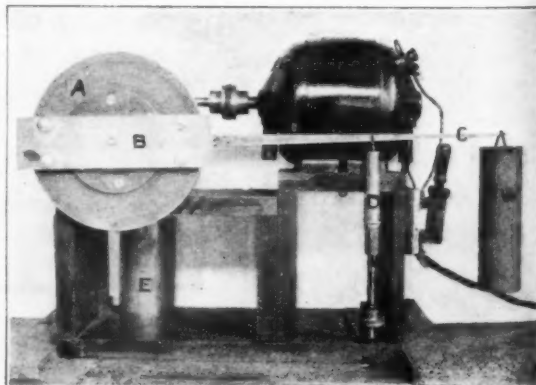
electrodes so that these are not unduly heated. Other torches have been built suitable for automatic welding using machine feed. The electrodes are ordinarily separated three or four millimeters and the arc assumes a fan shape extending

Right: This rubber-tire testing machine operates on the principle of the Prony brake. In it, the friction surfaces of the brake are lined with pieces of the rubber to be tested. An abrasive wears against the rubber

Measurement of Tire Life

LONG wearing tires are the goal of all rubber manufacturers, but it is impossible for them to wait until actual service has worn out their tires to find out whether their product is actually good or not. For this reason many mechanical devices for reproducing road conditions are in use, but according to Ira Williams of the Mellon Institute of Industrial Research, none of the machines so far

(Continued on page 368)



Paper and Grinding

*[Abrasive Wheels in
Another Great
Industry]*



PAPER AND GRINDING

Axes and saws—made and kept sharp by grinding—fell the trees of the forest.

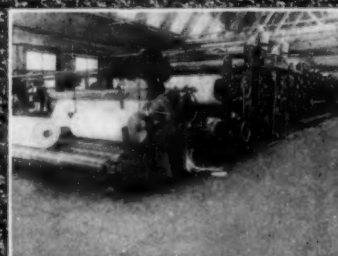
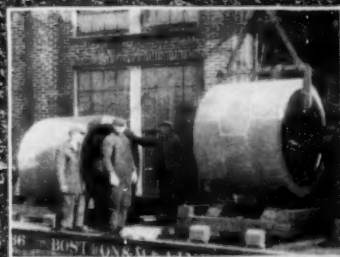
Mammoth man-made abrasive wheels now convert the trees into pulp.

In the paper-making machines and in the calendering processes that follow are a regular army of rolls—rolls upon whose proper functioning the very quality of the paper depends—rolls whose glassy smooth, accurate surfaces are formed by grinding.

Knives of razor edge—edges kept keen by grinding—trim the paper to size, hundreds of sheets at a single stroke.

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CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York University

Ship to Shore

CLARENCE D. CHAMBERLIN, transatlantic flyer, has added to his laurels, by making the first ship to shore flight from the deck of a merchant vessel, the *Leviathan* of the United States Lines.

Above the boat deck of the huge vessel, of nearly 60,000 tons register, a broad runway 114 feet long was built, extending from the starboard side of the first stack,

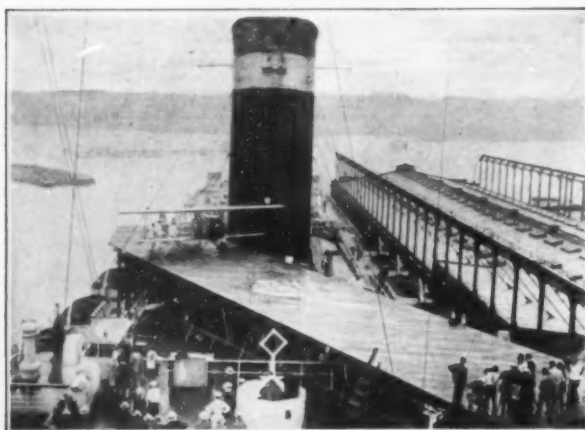
blasts came from the *Leviathan's* siren. Then the motor roared and the plane answered. The tail raised to flying position. Chamberlin gave the engine full throttle, pushed his stick forward, jumped his blocks and shot down the runway . . . the plane was off at 75 feet. Instantly the pilot lifted his ship into an almost perpendicular climb to an altitude of 500 feet. As the plane slowed almost to the

Chairman T. V. O'Connor and General Manager David A. Burke of the U. S. Shipping Lines are enthusiastic over the feat, which they characterize as a revolutionary boundary mark in ocean travel. Assistant Postmaster-General Irving W. Glover states that the Post Office Department has under consideration the plan of attaching to each transatlantic liner, an auxiliary airplane. The plane would remain on shore until the vessel was from 24 to 48 hours at sea and then catch it with last minute mail and passengers. The ship would then carry the plane to within an equal distance from the European shore, when the plane would hop off with mail and passengers and beat the vessel to port. With such a service in operation, it is estimated that the transatlantic mail time could be cut to less than 72 hours.

As Chamberlin is the first to admit, however, not all the difficulties in such a plan have been overcome. In this first trial, the loading of the plane was light, and there was a strong wind to be added to the speed of the vessel. With a plane heavily loaded and little wind, even the long platform might prove insufficient for a get-away, yet the platform would be a most unwieldy structure for almost any liner other than the *Leviathan*. Chamberlin himself advocates the use of a catapult as being likely to give safer and more reliable service. He also considers the advisability of adopting forward masts of the arch type. This would enable the plane to take off on a runway that ran directly off the bow, and through the divided mast, thus greatly simplifying the problem of maneuvering the vessel so as to get the resultant wind in line with the runway.

Among other plans discussed is that of using a huge net to be rigged atop ships into which airplanes could drop their mails after overtaking the surface vessel.

(Continued on page 360)



Chamberlin's Fokker biplane on the runway specially built on the deck of the *Leviathan* for a test flight from ship to shore. This was made to determine the possibility of speeding up transatlantic mail service by means of a supplementary aerial transport

to the port side of the deck above the bridge. To help the process of getting off, the runway was inclined at an angle of three degrees, with a leveled-off portion toward the bow to eliminate a diving tendency after the get-away. At the time of the test, there was a wind of 15 miles an hour, and the *Leviathan* itself was steaming at about the same speed.

Commodore Hartley so maneuvered the *Leviathan* that the wind was practically athwartship. The resultant velocity of the air relative to the vessel was therefore in the direction of the longitudinal axis of the runway, and the magnitude of this resultant velocity was approximately 20 miles per hour. Thus Chamberlin had ideal wind conditions. His Fokker biplane, equipped with a Wright Whirlwind engine, was lightly loaded, carrying only 900 pieces of mail, in addition to the pilot, and some two hours supply of gasoline.

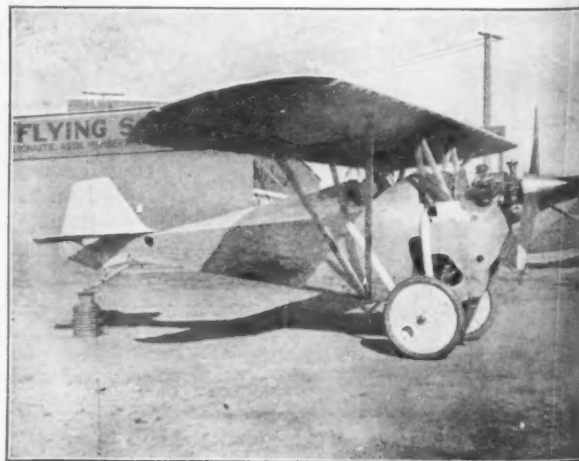
The pilot only had to stick to the runway for a distance of 75 feet, before his speed, plus the relative speed of the wind, sufficed to get him into the air. Chamberlin had admitted that he could "swim about a stroke," but had added with his characteristic quiet smile, "I am going to fly, not swim."

There was a driving rain at the time, and the pilot wore a borrowed rain coat that was somewhat too large and flapped about his legs. The *New York Times* thus graphically describes the beginning of the flight: "The flier played with the controls for a moment, testing his rudder, the ailerons and elevator. Four short

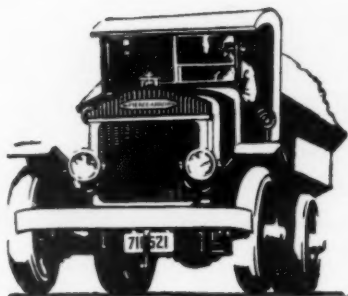
stalling point, Chamberlin pulled it over in a slow backward turn and straightened out to dive back toward the *Leviathan*. As he swooped down he pulled back his stick and zoomed high over the masts."

After paying his respects by other startling maneuvers to the *Leviathan* and to the Coast Guard destroyers acting as escorts, Chamberlin covered the distance between a point at sea 80 miles east of the Ambrose Light to Curtiss Field, Garden City on Long Island, in a little over an hour, greeted his friends, and then flew to Teterboro, New Jersey, delivering his mail bag safely to the Postmaster.

The two-cylindered monoplane shown at the right was constructed by W. F. Hopkins and T. Mead, North Island, California, navy men. It has a wing spread of 20 feet and is only 17 feet long overall. It is said to be able to carry the pilot and fuel for two hours flight



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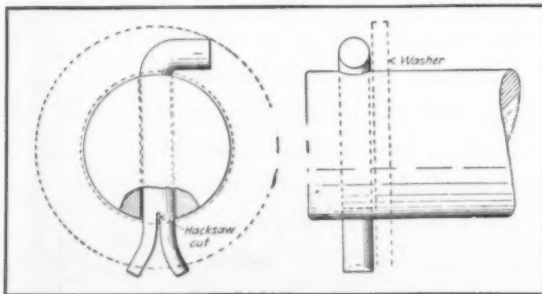
CONDUCTED BY A. P. PECK

Large Cotter Keys Made from Round Iron Rod

ACCORDING to F. Bentley, writing in *Power*, large cotter keys are seldom handy when one wants them, and frequently rather impractical substitutes are used.

A practical large cotter key up to one-

fit the eye-piece of the microscope and so notched on either side as to admit the bridge of the nose to such a position that the functioning eye is exactly opposite the center of the ocular lens. By having the screen notched for the nose on both sides, it is possible for the



Large cotter keys or pins are often hard to find. Also, they must be strong in order to be of value in most mechanical work. At the left is shown how to make a pin that will be strong in the extreme, and can be made in any size required to fit any particular job

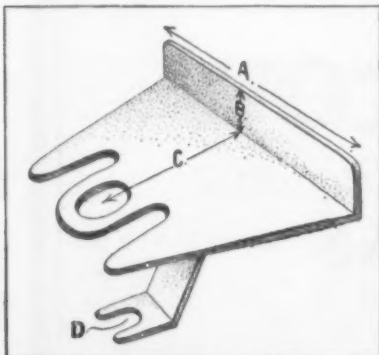
half inch can be quickly made of the body of a bolt or piece of round rod as shown in the illustration. The tail is split with a hack-saw only a little farther than the edge or face of the rod it is spread against. Almost any iron rod will stand a right-angle bend in the vise without fracture to make the head.

Such a key is much easier to punch out after it rusts in, and it will cover a washer and hold it as well as the standard pressed keys.

Light Screen for Use on Monocular Microscopes

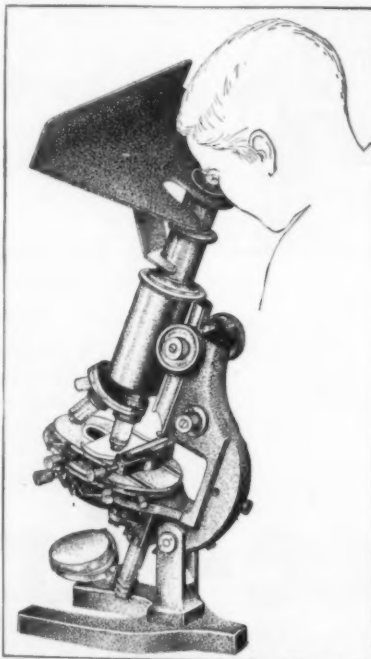
THE accompanying sketches illustrate a simple device which may easily be attached to any ordinary monocular microscope for the purpose of screening the eyes of the microscopist from slanting rays of light and also from the distracting secondary vision of the "off" eye.

The device may consist of a single sheet of light metal (preferably aluminum) or rigid cardboard, so cut as to



A detailed view of the eye shield for monocular microscopes. It is easy to make from the directions given

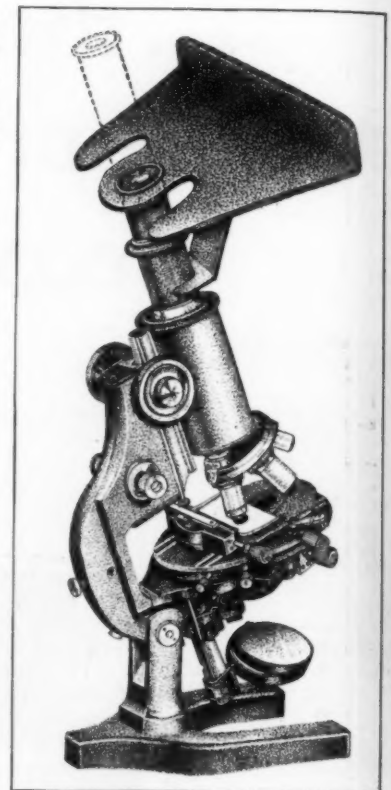
worker to alternate the use of his eyes, thus further reducing the eye strain. The horizontal portion of the screen is calculated to shut off secondary vision



The eye shield in use. Notice that it can be used for either eye of observer

as well as interfering light rays, while the vertical portion acts principally in the exclusion of slanting light rays from the worker's eyes.

This device has been used by the writer for several years, being found particularly advantageous as an aid in prolonged or continuous use of the mi-



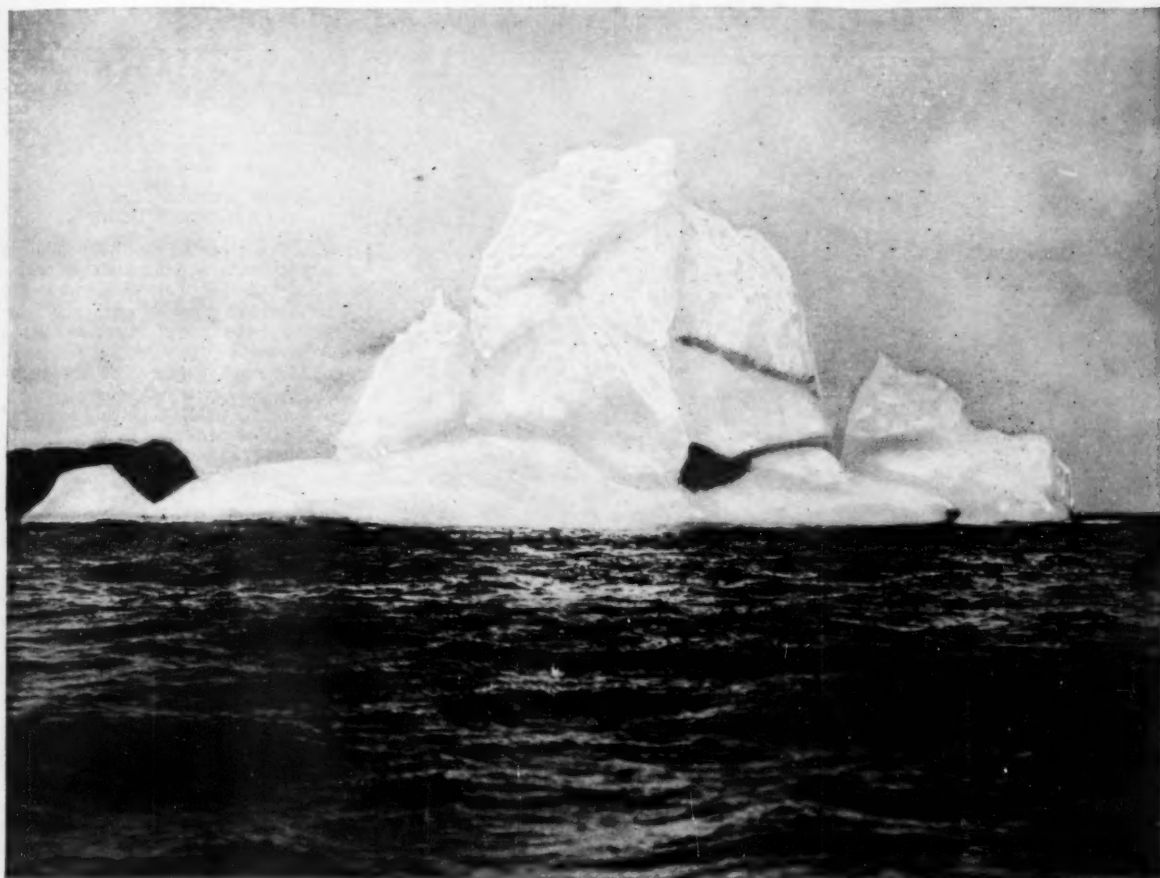
Another view of the light screen. This shows how shield is attached

croscope. It is made of thin, light sheet aluminum shaped after a cardboard pattern that was previously fitted to the worker's physiognomy. The device is coated with dull black paint to prevent the reflection of light as much as possible. A very satisfactory pasteboard screen can readily be improvised in any laboratory with a sheet of pasteboard, a pair of scissors and a small quantity of India ink or dull black paint.

One of our illustrations shows the perspective of the device. The entire width (A) is 14 inches, the height of the perpendicular screen (B) is three inches, and the depth of the horizontal screen (C) is four and one-half inches to the center of the eye piece. A forked brace (D) supports the weight of the shield from beneath.

A second drawing shows the method of attaching the device to the microscope, by first removing the eye piece, inserting the screen, then replacing the eye piece through the eye hole in the screen. The device is also shown in use.—Contributed by Dr. Hubert Bunyee, Bureau of Animal Industry, United States Department of Agriculture.

AFTER SHAVING



HERE IS A GOOD BET

Have you ever tried Listerine after shaving? You will like it.

We are so certain of this that we are willing to risk the cost of this page to tell you about it.

After your next shave, just douse Listerine on full strength and note results. Immediately, your skin will tingle with new life and vigor. Then, over your face will steal

a lingering and delightful sense of coolness such as you have never known before.

And as it cools, Listerine also heals—takes the smart and burn out of tiny wounds left by the razor and lessens the danger of infection. Go ahead and try Listerine this way. We dare you. Lambert Pharmacal Company, St. Louis, Mo., U.S.A.

EVERYBODY'S
TALKING
Everybody's talking
about the marvelous
whiteness of teeth after
using Listerine Tooth
Paste a short time.
You will be delighted.
Large tube 25c.

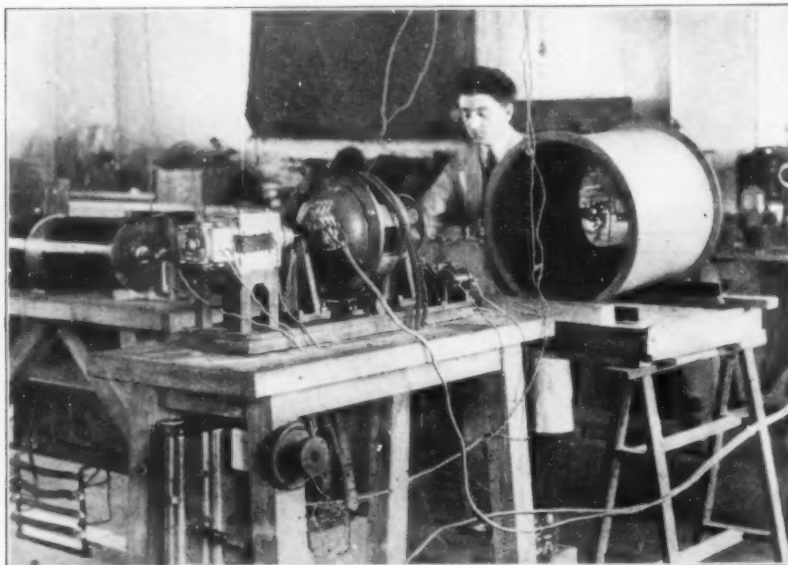
LISTERINE

—the safe antiseptic

Radio Notes

A Monthly Review of Progress in Wireless Communication

CONDUCTED BY ORRIN E. DUNLAP, Jr.



Belin's photo-radio transmitter based upon the principle of scanning the image to be transmitted with a rapidly moving spot of light. The arc light at the left produces the light beam which is reflected by a pair of oscillating mirrors. These throw the beam across the image and onto the photoelectric cell in the large cylinder. The varying impulses of light actuate the transmitter by means of the current controlled by the photoelectric cell

Prospecting by Radio

THE theory of prospecting by radio is as follows: Ore bodies located in the earth act as good conductors of electricity, and can act as antennas. Sulfide ore bodies are good conductors of electricity, the same as copper-wire antennas. The radio waves create an oscillating current of electricity in ore bodies, the same as in antennas. Any oscillating current will radiate waves of its own. Therefore the ore body in theory may become a miniature radio station, due to the oscillations created in it. This phenomenon is called re-radiation. Ore bodies throughout the world are continually absorbing and re-radiating radio waves sent out by radio stations. The reradiated waves, however, are so feeble that they cannot easily be detected.

Therefore, in prospecting, a specially designed transmitter is set up in the immediate neighborhood to be prospected. The ore body receives strong waves from the near-by transmitting station and therefore reradiates a fairly strong wave. The latter is picked up by a loop receiving outfit located close by.

The loop antenna is rotated around a horizontal and vertical axis and thus it becomes a radio compass. Headphones are connected with the apparatus and as the loop is rotated, the position of maximum and minimum sound is determined and the instrument readings are recorded. The direction and location of the ore body can then be computed from these readings.

In practical prospecting, when there is an indication of an underground conductor,

such as an ore body, and it is desired to make the information as definite as possible, a large number of readings are taken at intervals of 25 to 50 feet across the suspected axis of the ore body, and for a distance along the axis as far as it is desired to investigate. These readings

are then correlated on paper and cross sections made. The location of the ore body is said to show quite plainly on such cross sections.

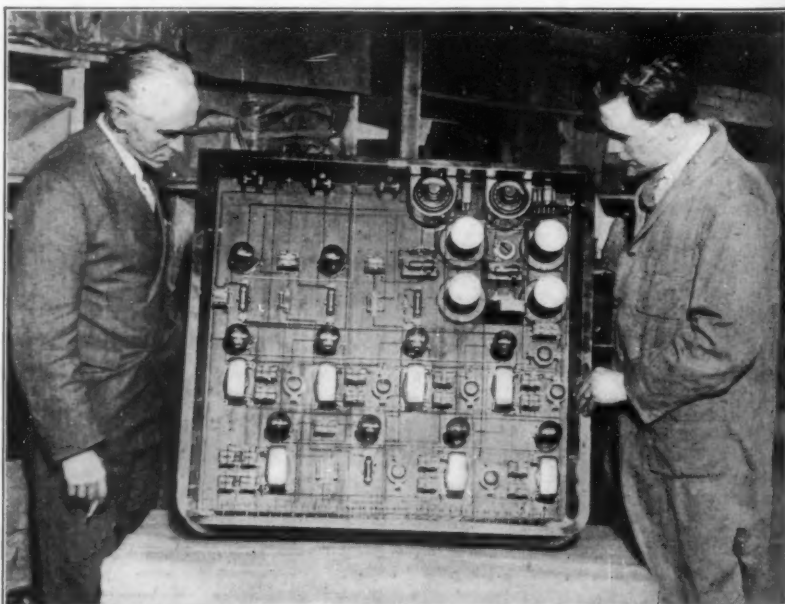
Bright Future Seen for Socket-Power Units

THAT the demand of the radio public is for convenient and dependable operation of the radio set from the light socket without sacrifice of radio quality or performance was the opinion expressed to the manufacturers in convention by Walter E. Holland, research engineer of the Philadelphia Storage Battery Company.

"The listening public is getting more and more critical of performance and will not tolerate distortion or hum." Mr. Holland went on. "Quality must not only be retained but must be improved. Furthermore, the public does not want to be limited to low power or so-called dry-cell tubes.

"So far, economy of operation has not been a major factor in radio. The prospect has bought the best set he could afford, or in many cases, the set his friends talked about, whether or not he could afford it, and has not counted the costs. This is passing. With more and more good sets to choose from, economy will be the deciding factor in many instances.

"It is to the advantage of the customer to purchase standard socket-power equipment that may be used to operate any good radio set. He is then free to choose his set on its merits alone rather than to choose some special set because it is designed for light-socket operation. He is also free to change to another set if he desires, without sacri-



Wide World

This radio set, built for the St. Giles Hospital, Camberwell, England, is designed to operate 550 pairs of headphones and 42 loudspeakers

All Electric Radio

Single Dial 7 Tube Set—30 Days Free Trial

Agents! Dealers! Big Profits!

Make Big Money taking orders for Metrodyne— all or part time. Metrodyne All Electric Radios are in a class by themselves. Unequaled for quality, performance and price. Demonstrate at home and take orders. Lowest wholesale prices. Your Demonstrating Set on 30 days' FREE trial. Mail the coupon below for complete details.



Three Year Guarantee

Metrodyne

ALL ELECTRIC RADIO

"Simply press the switch button and it's on"

NOW! A real electric radio set! Costs less than most battery sets. No batteries—no chargers—no eliminators—no acids—no liquids! Shipped direct from our factory at rock bottom prices and on 30 DAYS' FREE TRIAL.

At last! The radio you've dreamed about! If you have electricity in your home you can now really enjoy coast to coast radio reception without the care, bother and muss of batteries, chargers, eliminators, etc. The Metrodyne All Electric is a real, genuine batteryless radio set. Simply insert the plug in the socket, press the switch button and "tune in."

You could not possibly buy a better radio set than the Metrodyne All Electric, no matter what price you paid.

COSTS LESS THAN MOST BATTERY SETS

Do not confuse the Metrodyne All Electric radio with ordinary light socket sets, because the Metrodyne is truly an all electric radio—consumes less than 2c worth of electricity a day. Comes to you direct from the factory. Its low cost brings it down to the price of an ordinary battery set. We are so confident that you will be delighted with this wonderful, easy-to-operate batteryless radio that we offer to ship it to your home for thirty days' free trial—you to be the judge.

GORGEOUS CONSOLE ELECTRIC RADIO

Here is the Metrodyne All Electric Console Radio—a gorgeous, genuine walnut cabinet, in a beautiful two-tone finish. Has a built-in genuine Metro-Cone large size speaker. Brings in programs with great volume, reproducing the entire range from the lowest to the highest notes with remarkable clearness and distinction. All metal parts are finished in old gold. Wonderful electric radio, in a cabinet that will beautify the appearance of any home.

BEAUTY—EFFICIENCY DEPENDABILITY

The Metrodyne All Electric table model Radio is a 7 tube, single dial set. Only the highest quality low loss parts are used throughout. Solid walnut cabinet, beautiful two-tone effect, with handsome gilt metal trimmings. Size of cabinet, 28 inches long, 13 inches deep, 10 inches high. Has electrically lighted dial—easy to log stations, even in the dark. Only one dial to tune in all stations. Excellent tonal qualities—wonderful volume—very selective.

METRO ELECTRIC COMPANY

2165 N. California Ave. Dept. 692 Chicago, Illinois

no
~~A-Batteries~~
~~B-Batteries~~
~~C-Batteries~~
~~Eliminators~~
~~Chargers~~
~~Acids~~

**30
DAYS
FREE
TRIAL**

We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal 30 days' free trial offer, which gives you the opportunity of trying before buying. Thousands of Metrodynes have been bought on our liberal free trial basis—Write Today!

FREE TRIAL COUPON

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Chicago, Illinois

Gentlemen:

Send me full particulars about Metrodyne All Electric Radio and your thirty days' free trial offer.

Name.....

Address.....

If you are interested in AGENT'S proposition place an "X" in the square ☐

Mail This Coupon

Learn all about the marvelous Metrodyne All Electric Radio before buying any radio set. Let us send you the proof of quality. Read the letters from thousands of enthusiastic owners. Get our rock bottom direct-from-factory prices and our liberal thirty days' free trial offer.



Wide World

Engineer in cab of freight locomotive talks by radio with men in caboose

ficing his investment in the power equipment," said Mr. Holland.

"Present radio receivers with standard tubes, socket-powered with the present indirect system of 'A' power and good rectifier-and-filter 'B' power, set a very high standard of performance, convenience and economy. With this high standard established as a criterion, together with the great commercial advantages, it is not likely that alternating-current tubes or other new devices will quickly supplant the present tried-and-true system. The alternating-current tube, no matter how good it may be in its ultimate development and application, can only closely approach or at best, equal present standards of performance. It is not within the bounds of probability that it will attain such perfection without going through a long period of quantity production."

Latest Radio System for Freight Trains

THE practicability of a locomotive engineer sitting in his cab conversing by radiophone with a brakeman in a caboose at the rear end of a freight train one mile long, was recently demonstrated in tests conducted by the General Electric Company and the New York Central Railroad.

The cab and caboose were equipped with the necessary aerials and transmitting and receiving apparatus. Short waves were used in order to avoid interference with the regular broadcasting stations. The engineer shouted that a collision was impending and he ordered the brakeman to throw the emergency valve to stop the train. The command was received in the caboose, the engineer's voice coming through clear and strong.

Radio communication will be valuable on trains made up of from 75 to 125 cars, where the engineer and conductor are separated by a mile of train, according to railroad officials. They point out that heretofore signaling between the extreme ends of long freight trains has been done by whistles or by flare lights, which often fail because of curves in the route or because of inclement weather conditions. Furthermore, if a defect ever developed in a long train the conductor either had to send a brakeman on the dangerous trip along the tops of the cars to inform the engineer, or he had to pull the emergency valve to stop the train. Time can be saved by the radio method.

When radio communication is desired, a signal is given by either the engineer or the man in the caboose pressing a button, which causes a howling noise to attract attention at the other end of the train.

"Dummy" Aerial Used in First Test

A HALF-HOUR before a broadcast period is to be heard from either WEA or WJZ, the transmitters are placed on a test on a "dummy" antenna, consisting of large banks of electric lamps lighted by radio-frequency energy and providing the equivalent of the actual radiation system. Frequency measurements are then made throughout the entire transmitter, insuring that the apparatus is functioning properly.

When a broadcast period is ready to go on the air, a signal is received at the transmitter from the studio. Immediately, the carrier wave is fed into the antenna, and this fact is in turn signaled back to the studio. In the case of WEA, this signal is automatic, since the carrier wave

energizes a coil which operates a relay in the control room, illuminating a green light on the announcers' control box in the studio.

As a rule two operators compose the watch at the transmitter. One of them occupies himself with the transmitter proper, while the other listens in on the 600-meter ship communication channel so that the station may be shut down immediately in case an SOS signal is heard. While it is a matter of pride that the station be kept continuously on the air, it is equally important that broadcasting be discontinued if a signal of distress is being sent out by a vessel at sea.

Broadcast listeners who have difficulty in separating programs from their local stations will probably be interested to know that at WEA and WJZ this 600-meter watch is constantly maintained directly beneath the stations' antennas, in spite of the fact that WEA operates on 491.5 meters, and WJZ on 454.3 meters. So efficient is the receiving equipment that in addition to hearing near-by ships and coastal stations, the 600-meter "watchman" usually listens to vessels in South American and European waters and land stations in these same localities during the course of an evening.

New York Leads

THE ranking of states as radio markets, tabulated from passenger automobile registrations, broadcasting stations, income tax returns and population, shows that New York leads the country with 10.09 percent of the business, having 655,850 sets in use. The closest rival is Pennsylvania with 7.74 percent of business, using 503,100 sets. Illinois comes third with 7.20 percent of business done, having in use 468,000 sets. This is followed by California, with 6.34 percent of business, using 422,100 sets, and Ohio, with 5.59 percent, or 363,350 sets.

The saturation comparison to date is as follows: Number of homes in the United States, 26,800,000; number of phonographs, 11,000,000; number of passenger automobiles, 18,000,000; number of telephones, 17,000,000; number of homes wired for electricity, 15,900,000; number of farms, 6,370,000, and number of homes without radio sets, 20,300,000. The radio saturation totals 24 percent, showing that more than three quarters of the country is still a potential market for radio apparatus, sets and parts, and the farms represent a most fertile market.



A freight locomotive equipped with radio for communication with other end of train. Antenna parallels the boiler on each side

Restored Enchantment



This is the Eveready Layerbilt that gives you Battery Power for the longest time and the least money.

THERE is no doubt of it—radio is better with Battery Power. And never was radio so worthy of the perfection of reception that batteries, and batteries alone, make possible. Today more than ever you need what batteries give—pure DC, Direct Current, electricity that flows smoothly, quietly, noiselessly. When such is the current that operates your receiver, you are unconscious of its mechanism, for you do not hear it humming, buzzing, crackling. The enchantment of the program is complete.

Batteries themselves have improved, as has radio. Today they are so perfect, and so long-lasting, as to be equal to the demands of the modern receiver. Power your set with the Eveready Layerbilt "B" Battery No. 486. This is the battery whose unique, exclusive construction makes it last longer than any other Eveready. Could more be said? In most homes a set of Layerbilts lasts an entire season. This is the battery that brings you Battery Power with all its advantages, conferring benefits and enjoyments that are really tremendous when compared with the small cost and effort involved in replacements at long intervals. For the best in radio, use the Eveready Layerbilt.

EVEREADY
Radio Batteries
—they last longer



Radio is better with Battery Power

At a turn of the dial a radio program comes to you. It is clear. It is true. It is natural. You thank the powers of nature that have once more brought quiet to the distant reaches of the radio-swept air. You are grateful to the broadcasters whose programs were never so enjoyable, so enchanting. You call down blessings upon the authority that has allotted to each station its proper place. And, if you are radio-wise, you will be thankful that you bought a new set of "B" batteries to make the most out of radio's newest and most glorious season.

NATIONAL CARBON CO., INC.  New York—San Francisco

Unit of Union Carbide and Carbon Corporation

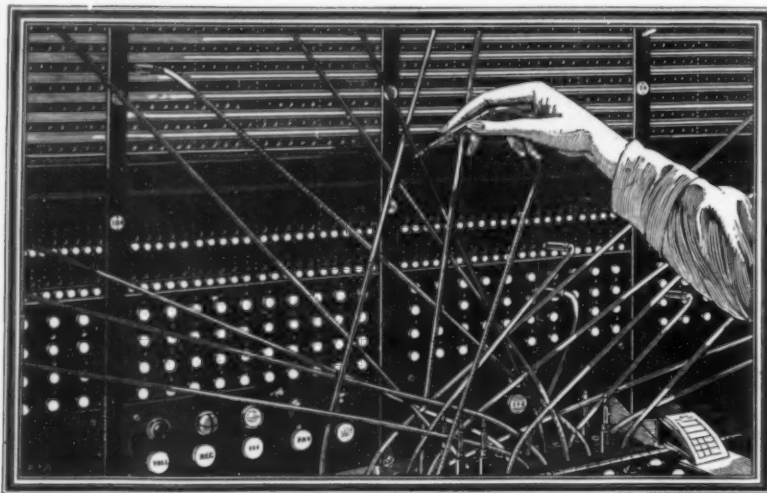
Tuesday night is Eveready Hour Night—9 P. M., Eastern Standard Time

WEAF—New York	WGR—Buffalo	WGN—Chicago	WRC—Washington
WJAR—Providence	WCAE—Pittsburgh	WOC—Davenport	WGY—Schenectady
WEEL—Boston	WSAI—Cincinnati	WCCO—Minneapolis	WHAS—Louisville
WDAF—Kansas City	WTAM—Cleveland	WCCO—St. Paul	WSB—Atlanta
WFI—Philadelphia	WWJ—Detroit	KSD—St. Louis	WSM—Nashville
		WMC—Memphis	

Pacific Coast Stations—9 P. M., Pacific Standard Time

KFO—KGO—San Francisco	KFI—Los Angeles
KFOA—KOMO—Seattle	KCW—Portland

Have you heard the new Victor record by the Eveready Hour Group—orchestra and singers—in Middleton's Down South Overture and Dvorák's Goin' Home?



The Switchboard

*An Advertisement of
the American Telephone and Telegraph Company*

A WEB of cords plugged into numbered holes. A hand ready to answer signals which flash from tiny lamps. A mind alert for prompt and accurate performance of a vital service. A devotion to duty inspired by a sense of the public's reliance on that service.

Every section of a telephone switchboard typifies the co-ordination of human effort and mechanism which makes possible America's far-reaching



telephone service. Its cords link for instant speech those who are separated by a few miles or by a continent. Its guardian operators are of the telephone army—men and women vigilant to meet a nation's need for communications.

In plant and personnel, the Bell System is in effect a vast switchboard serving a nation that has been transformed into a neighborhood through telephone growth and development.

Learning To Use Our Wings

(Continued from page 352)

An alternate plan would be to use seaplanes to overtake the liner, land beside her and be picked up later.

Whatever the ultimate method employed, there is no doubt that what is now a startling innovation will ultimately become as much a matter of routine as taking on the pilot.

Safe Aircraft Competition

ACCORDING to Colonel Guidoni, to say that air transport has now attained the safety of other methods of transport is an incorrect statement. It is, according to Colonel Guidoni, sufficient to compare air transport with that by motor vehicles, railways and ships. Last year in the United States, for ten million motor cars there were 15,000 deaths. Allowing 450 running hours per year for every motor vehicle, carrying two persons, there is a death every 300,000 hours or one for every 600,000 passengers. It is to be noted that most of the killed were pedestrians. An English railway company during last year carried over 40 million persons without a single fatality. A motor-bus company carried 600 million passengers with 10 deaths, that is, one death in 60 million passengers. The figure for marine transport is difficult to give as there are no exact statistics, but counting all transport services utilizing water craft, there was not one death in 300,000 passengers. In a continental commercial air service, from 1921 to 1926, there has been one death per one thousand passengers; in another, on the other hand, there was only one death per 55,000 passengers.

Aviation safety is constantly improving. Figures for the last year or so would be much more to the point. Certainly in the United States safety in flying is greater than that shown by the above European air services. Much remains to be done, however.

Aviation safety depends on many things; aerodynamic characteristics; fire prevention; reliability of the power plant; weather; radio and lighting and other aids to aviation; inspection of ships and pilots; ground organization, et cetera. It is hard to say which is the most important. Certainly aerodynamic characteristics need to be improved.

The Daniel Guggenheim Fund for the Promotion of Aeronautics has made the encouragement of safety one of its main objectives, and as its first line of attack it announces the Daniel Guggenheim Safe-Aircraft Competition "to achieve a real advance in the safety of flying through improvement in the aerodynamic characteristics of heavier-than-air craft, without sacrificing the good practical qualities of the present-day aircraft."

To this end the Fund is offering a First Prize of 100,000 dollars, and five "Safety Prizes" of 10,000 dollars each, which will be awarded in accordance with the Competition Rules.

Major Mayo has thus summarized the aerodynamic weaknesses of present day aircraft:

1. The landing speed is far too high and the length of run after landing is too great.
2. The gliding angle is too flat, making the approach to a given spot

CHEMISTS

Our new catalog listing 5000 Chemicals, 2500 illustrations Laboratory Apparatus and 1000 Books sent on receipt of 50c.

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637 East 71st Street Chicago, U. S. A.

WANTED, MEN

To Make Metal Toys and Novelties



Big demand for Soldiers, Cowboys, Ashtrays, S & 10c Store Novelties, Auto Radiator Ornaments and other all year sellers. We operate in selling goods you make, also buy them from you. Small investment puts you on road to success. WE FURNISH COMPLETE OUTFITS AND START YOU IN WELL PAYING BUSINESS. No experience necessary. ACT QUICKLY. If you want to get in BIG CHRISTMAS RUSH and handle wholesale orders now being placed. Write at once for full information.

Metal Cast Products Co.

1496 Boston Road, New York

WANTED

A line of small turned or sawed wood specialties by progressive Massachusetts concern having low cost water power and experienced facilities for advertising and selling attractive articles. Royalty basis. Send samples with cost estimates. Address Box 176, Scientific American.

TELESCOPES

Send for Catalog

WILLIAM MOGEY & SONS, Inc., Plainfield, N. J.



BROKEN? FIX IT WITH INSA-LUTE
(Liquid Porcelain) ADHESIVE CEMENT

IT'S DIFFERENT!
"Sticks Like Cold Solder"
For Factories, Schools, Homes, etc.
Trial Can—25c—Stamps or Coin
TECHNICAL PRODUCTS CO.
S. Sheridan St. Pittsburgh, Pa.

for landing too difficult for safety.

3. The length of run before taking off is too great.

4. The angle of ascent after taking off is not great enough.

5. If the airplane is stalled (that is flown at too big an angle to the air stream), it becomes unstable and at the same time control is lost.

The rules of the competition are a derivative of this summary.

The aircraft must have a reliable power plant, good structural characteristics, carry five pounds of useful load per horsepower, and have adequate vision and accommodation. These rules insure that the aircraft satisfies the requirements of good, present-day practice.

Further the aircraft must show good stability, ability to recover from abnormal flight conditions, be perfectly controllable and maneuverable, and particularly be perfectly safe when the engine suddenly fails on a steep climb—a condition frequently followed by a dangerous stall.

Further specific points are awarded on the following tests:

1. Speed Tests.

(a) Two points for every mile per hour less than 35 miles per hour at which level flight can be maintained, up to a maximum of 10 points.

(b) Four points for every mile per hour less than 38 miles per hour which is not exceeded in a steady glide, up to a maximum of 10 points.

(c) One point for every two miles per hour in excess of 100 miles per hour at which level flight can be maintained, up to a maximum of 10 points.

2. Test of Landing Run.

Two points for every three feet less than 100 feet in coming to rest after first touching the ground, up to a maximum of 40 points.

3. Test of Landing in Confined Space.

One point for every two feet less than 300 feet from the base of an obstruction 35 feet high in coming to rest after gliding in over the obstruction, up to a maximum of 75 points.

4. Test of Take-Off.

One point for every 15 feet less than 300 feet required to take off from standing start, up to a maximum of 15 points.

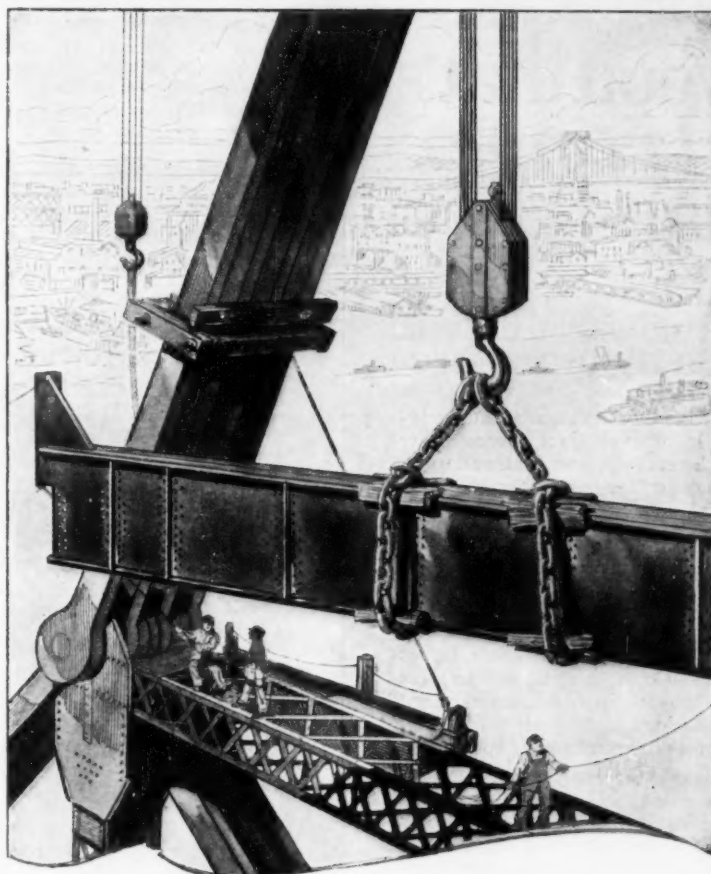
One point for every 10 feet less than 500 feet to clear obstruction 35 feet high from a standing start, up to a maximum of 26 points.

The ideal machine which would achieve the total of 200 points would have the following characteristics: Maximum speed, 130 miles per hour; minimum speed with power, 30 miles per hour; minimum gliding speed, 32 miles per hour; landing run, 40 feet; landing over an obstruction 35 feet high in 150 feet; take-off in 75 feet; clearing an obstruction 35 feet high on take off in 240 feet.

There is not the slightest doubt that such a machine would be wonderfully safe to fly! The Safe Aircraft Competition is likely to produce almost revolutionary improvements in aviation safety.

A One-Wheel Plane

THE manufacturers of the well-known Loening amphibians, which have carried the "good-will" fliers to South America and back, are now producing an amphibian with but a single wheel,



Bridge Builders

Co-workers in the stupendous task of spanning water with steel, are the brawny men and still more brawny cables. Together they fabricate the massive structure and anchor its ends to either shore.

Yellow Strand Wire Rope has always been as great a bridge builder, as it has been a builder of canals and dams, factories and office buildings.

Wherever there is heavy work to do, there you will usually see the familiar strands of yellow that distinguish this powerful wire rope from all others.

Yellow Strand is the highest grade rope that this fifty-one-year-old company knows how to make. They also manufacture all the standard grades, for all purposes, each supreme in its class.

BRODERICK & BASCOM ROPE COMPANY
805 North First St., St. Louis, Mo.

Eastern Office & Warehouse: 66-70-72 Washington St., New York City, N. Y.
Western Office: Seattle
Factories: St. Louis and Seattle

Authoriz. Dealers in all Industrial Localities

Yellow Strand WIRE ROPE

LR647

Use "Plylock" Wood that's stronger than wood



an industrial material
of a thousand uses

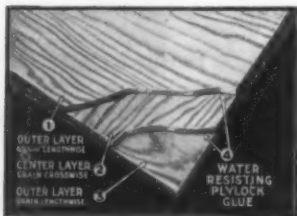
PLYLOCK is a laminated Douglas Fir product, exceedingly strong, light, and easily adapted to an immense number of industrial uses.

It is built up of sheet upon sheet of the finest Douglas fir veneer, permanently cemented together with Plylock cement, under tremendous hydraulic pressure.

Single panels with outer layers in one piece may be had in sizes as large as 4 by 8 feet. Standard construction is 3-ply and 5-ply, in thicknesses from $\frac{1}{4}$ to $\frac{3}{4}$ inch.

Manufacturers of automobile bodies, trunks and cases, cabinets and cabinet doors, phonographs and radio sets, shelving, toys, desks and furniture, and innumerable articles in which wood is used, will find Plylock a means of improving strength and quality. And Plylock is not an expensive material. Its use means substantial cuts in both manufacturing and material costs.

Write for full information regarding Plylock. Samples will gladly be supplied for experimental and development work at your own plant, and our research department is at your service. Send for a copy of "The Pictured Story of Plylock."



Sample of Plylock, 3-ply, cut away to show construction

PLYLOCK

"Wood that's stronger than wood"

PORTLAND MANUFACTURING COMPANY, PORTLAND, OREGON

offering obvious advantages in cutting down weight and complexity of the retractable landing gear. The only modification of the general design which seems necessary is that the tip-floats should be provided with long, flexible skids, protecting the wings when the plane rolls to one side or the other on the ground.

We should judge that "taxying" such a plane on the ground would be no harder than riding an ordinary bicycle. At any rate the Army Air Corps, bent

on testing the idea, took an old training plane, equipped it with a single central wheel and found that the idea was practical. We have no exact details of the tests. Probably the pilot has to turn toward the side which is for an instant dangerously low; the centrifugal force produced by the turn should quickly right the plane into a normal position. Our Air Corps pilots are so used to "stunts" of every kind, that these acrobatics no doubt provide them with an enjoyable novelty.

The Heavens in October

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: Oct. 7.
At 10 1/2 o'clock: Oct. 14.
At 10 o'clock: Oct. 22.

At 9 o'clock: Nov. 7.
At 8 1/2 o'clock: Nov. 16.
At 8 o'clock: Nov. 23.

At 9 1/2 o'clock: October 30.
The hours given are in Standard Time.

NIGHT SKY: OCTOBER AND NOVEMBER

The Heavens

OUR map this month shows the principal constellations, the Dipper low in the north, Draco and Ursa Minor above, then Cassiopeia and Cepheus. Cygnus and Lyra are prominent in the northwest and Aquila in the west. The great and almost barren region in the center is brightened by the presence of Jupiter, and by Fornax lower down. Pegasus is higher in the south and Andromeda and Pisces in the east and northeast. Below them are Auriga and Taurus, while Orion and Gemini are rising.

The Planets

Mercury is an evening star all through the month, but is south of the sun, and so not very favorably placed. Even at his greatest elongation on the 18th, he sets only about an hour later than the sun.

Venus is a morning star, rising about 4:00 A. M. at the beginning of the month, and before 3:00 A. M. at its close, and is extremely bright.

Mars is in conjunction with the sun on the 21st, and is unobservable.

Jupiter is in Pisces and well placed for observation. He is due south at 11:14 P. M. on the 1st, and at 9:04 P. M. on the 31st.

Saturn is an evening star in Scorpio, setting a little after 7:00 P. M. in the middle of the month. Uranus is in Pisces, a little to the east of Jupiter, and is well observable telescopically. Neptune is a morning star, rising between 2:00 and 3:00 A. M.

The moon is in her first quarter at 9:00 P. M. on the 3rd; full at 4:00 P. M. on the 10th; in her last quarter at 10:00 A. M. on the 17th, and new at 11:00 A. M. on the 25th. She is nearest the earth on the 11th, and farther off on the 25th. While on her circuit of the heavens, she passes near Saturn on the 1st, Jupiter and Uranus on the 9th, Neptune on the 20th, Venus on the 21st, Mars on the 25th, Mercury on the 27th, and Saturn again on the 28th.

The Scientific American Digest

(Continued from page 348)

that has a British Thermal Unit cost approximately one-half of that of fuel oil, then," continues Mr. Jefferson, "it behooves the marine engineering fraternity to bestir itself and find out whether or not this type of power can not be put to work on ship board.

"That is the reason why the Fuel Conservation Committee decided to tackle the problem, for pulverized fuel has, on numerous shore plants, met the conditions just cited.

"But, if this has been worked out on shore, why should there be any marine installation problem?

"The answer to this is simply furnace design.

"In the average pulverized-fuel plant, where the rate of combustion has been less than a pound of fuel per cubic foot of furnace volume, deep or long furnaces have been used, which allowed flame travel of 20 feet, or more. This permitted comparatively slow flame propagation, or ignition of the individual particles of coal.

"This type of furnace design is not practical on ship board, and in the case of the Scotch marine boiler, it is not only impractical but impossible. The furnace of a Scotch boiler may be made smaller by installation of refractory lining, by accumulation of ashes and dirt, or by the collapse of the furnace, but it just cannot be made larger; it's not that sort of 'animal.'"

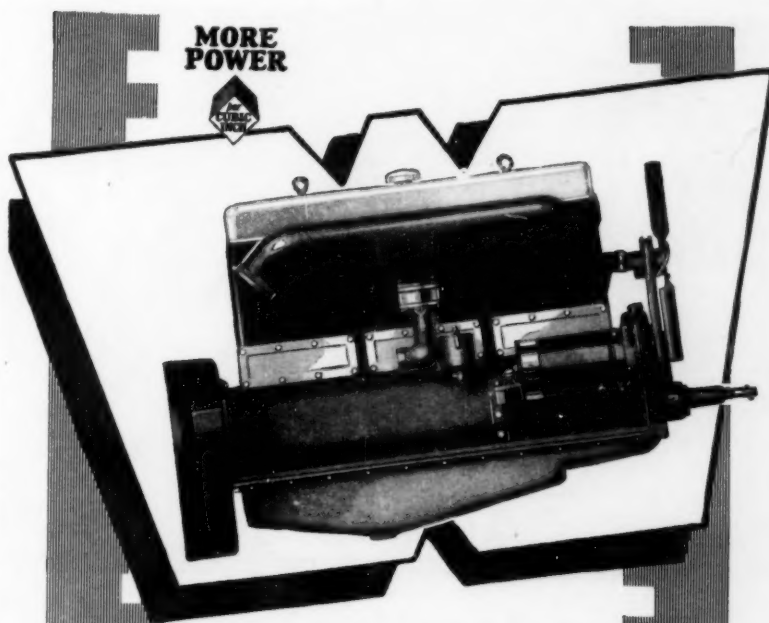
Explaining that the furnace of the ordinary Scotch boiler used on steamships allows only 11 feet for flame travel, instead of the needed 20 feet, Mr. Jefferson next tells how tests were made as long ago as 1921, in an effort to surmount this difficulty. It apparently became clear, however, that there was simply not enough combustion space in the boilers.

However, by 1925 the Fuel Conservation Committee was again convinced that further possible progress made along these same lines would eventually succeed.

"At almost the same time," says Mr. Jefferson, "further stimulus was given to the question by the numerous Diesel installations which have been made in the fleets of our foreign competitors.

"The fuel economy possible in a Diesel installation would drive steam off the seas, if it were not for the high initial cost of Dieselization. This high cost has retarded Dieselization considerably but has by no means stopped it, and the steam men have been forced into developing their equipment so as to reduce the differential in the operating fuel cost between the Diesel and the steam plant.

"High - pressure, high - temperature steam has received a considerable impetus and, with the reinforcement of pulverized fuel, it is possible to meet the challenge of the Diesel, not in terms of pounds of fuel per shaft horsepower, it is true, but in the terms which decide whether a business is profitable or not, that is, in the cost per shaft horsepower developed, and this with a plant whose initial cost will be materially less than that of the Diesel."



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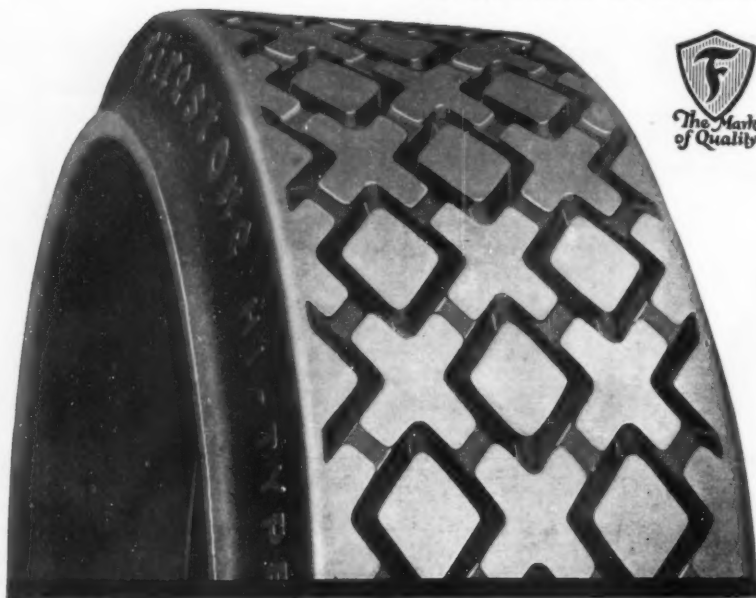
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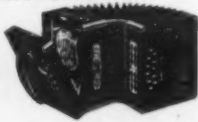
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Summing up with a prediction ominous to the marine Diesel engine, the author concludes that "pulverized fuel for marine purposes has gone through a considerable amount of the development work which will make it real sea-going, but it is not quite ready to shove off. However, it does give most encouraging prospects, and it is safe to say that within a comparatively short time the marine engineer, in studying his operating costs, is going to be forced to consider another competition against the hand-fired coal or the oil-burning steam plant—a competition which will also question the superiority of the Diesel's operating costs and will have the advantage of a reasonable initial installation charge.

Cleaning Eggs With An Artificial Sandstorm

OWING to the drudgery involved in cleaning eggs for market and the bad effect of water and washing compounds on the shell, a machine has been perfected and put into use which cleans the eggs by



Sandblasting eggs (1): The eggs are dumped three dozen at a time on a conveyor. They pass on at once into the dry-cleaning or sandblasting chamber in the rear

sandblast and simplifies grading and candling. Because of the excellent condition in which they reach the market, the sandblasted eggs bring from one to four cents more per dozen than eggs cleaned by other means. They also have a higher rating for storage purposes, because the former method of cleaning with chemicals softens the shell and speeds decomposition.

The egg-cleaning machine, several of which are in use in the Pacific northwest, has a capacity of 300 cases, or 9000 dozen eggs a day. The eggs are placed on a moving endless conveyor consisting of rubber-covered rolls. This conveyor carries them through the cleaner.

The rolls are so spaced as to prevent the eggs from falling through and are of such diameter as to keep adjacent eggs from touching one another. The motion of the rolls causes the eggs to rotate as they move from one end of the conveyor to the other.

The cleaner is a vertical compartment containing an ingenious sandblasting device. A fine grade of white sand is carried in a hopper in the tower of the cleaner. This passes downward through tubes to



Sandblasting eggs (2): Passing from the sandblast, the eggs are carried over a battery of powerful lights where they are candled

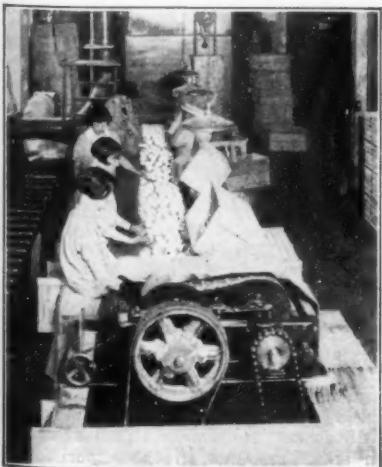
nozzles placed closely above the conveyor. Air, under low pressure, forces the sand in a fine spray upon the eggs as they are tumbled past the nozzles.

The cleaning compartment is enclosed and a vacuum is maintained by means of an exhaust fan. The dust is deposited outside the building. The sand falls into a pit in the base of the machine and is there picked up by bucket conveyors and carried back to the hopper. From the cleaner the eggs pass over powerful lights for candling.

At Last a Complete Astronomy

"THE most complete treatise on astronomy in the English language" is the accurate characterization applied by an astronomer friend of the reviewer, in speaking of Russell, Dugan and Stewart's "Astronomy" (Ginn and Company, 1927). For eight or ten years, until recently, there has been no thorough modern textbook of astronomy. Almost simultaneously several textbooks appeared in 1926 and 1927, but not one of them is based on so ambitious a plan as the splendid work under review.

The new work contains a total of 932 pages and is published in two volumes. Volume I is wholly devoted to the solar



Sandblasting eggs (3): The cleaned eggs emerge from the sandblasting chamber in a very short time and are next packed for shipment

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system. Volume II treats of the stars and astrophysics. Thus the book is more than an astronomy in the ordinary sense of the word; it combines an astronomy and an astrophysics. The volumes may, if desired, be purchased separately. It is anticipated that the second, on astrophysics, will require relatively frequent revision; the first volume much less so.

Contrary to expectation in the case of a relatively exhaustive work of this sort, the text is not abstruse; algebra appears to be the "most terrible" form of mathematics employed and there is very little, even, of that.

The senior author is Dr. Henry Norris Russell of Princeton who for 27 years has conducted a monthly astronomical department for this magazine, while the junior authors are also members of the Department of Astronomy at Princeton University, of which Dr. Russell is head. It is altogether unlikely that any author will attempt as ambitious a work as this within a decade or more, and the work will therefore be likely for a long time to occupy the central position in the field of relatively exhaustive text and reference treatises on general astronomy.

New Electric Cable Works as Continuous Push Button

A NEW type of electric cable for small currents, such as those used for sounding bells and buzzers and for starting and stopping machinery, has been invented by a Hungarian electrical engineer of Berlin, Germany, Oscar Nagy. It does away with the necessity for having push buttons at set points, for if the cable is squeezed at any place throughout its length the circuit is completed and the current does its work. This is accomplished by having the wires woven into a sort of loose braid, separated by an elastic non-conductor, which permits contact when pressure is applied.

Many uses are suggested for the new cable. It is expected to find a large use around complicated machinery, where threatened accidents to either operator or material demand instant stopping. Since it can be operated with feet, knees, elbows, or any other part of the body, its advantage over ordinary types of switches and levers is obvious. Hidden beneath carpets or otherwise concealed, it is expected to be useful in burglar alarm systems. Strung along trenches, or along the sides of naval vessels, it will enable officers to signal to their men from any point, and by rapid successive pressures messages can be transmitted in ordinary Morse code, making it an emergency telegraph system.

An especially interesting safety application is found in its use in mines and quarries, where a fall or slide of rock automatically sounds its own emergency signal.—Science Service.

Helium Found in Canada

UP to the end of 1926, over 25,000,000 cubic feet of helium has been obtained by the United States Government, and costs of production reduced to a basis that will permit of commercial utilization. Helium was also extracted in small amounts in the experimental plant at Calgary, Canada, operated under the direction of Prof. J. C. McLennan, F.R.S. of the University of Toronto in 1919-1920, for the British admiralty.

In the survey of helium resources in Canada made by the Mines Branch of the Canadian Government, it was found that the gas from three small wells at Inglewood, Ontario, contained as high a percentage of helium as that treated in the United States Government plant at Fort Worth, Texas. The Ontario Government has since taken up many of the leases in this neighborhood and it is anticipated that the Canadian National Research Council may establish an experimental helium extraction plant, if it be proved that sufficient gas is available. A few wells in other fields in Ontario, particularly in Norfolk county, yield gas carrying 0.5 percent helium. Natural gas in Alberta, where much larger quantities are available than in Ontario, was found to contain little or no helium, with the exception of that from the Bow Island and Foremost fields. If natural gas, containing as little as 0.2 percent helium, could be economically processed to extract helium, it is calculated that about 5,000,000 cubic feet could be obtained in Canada annually. Canada is the only present known source of helium in the British Empire.

The results of this investigation are described in a report, "Helium in Canada," by Dr. R. T. Elworthy, recently issued by the Mines Branch. It contains a brief account of the particulars and occurrences of helium, the methods employed in the work, particulars of the gas fields, including analyses of many gases, and some account of the methods of recovery of helium and its uses. Copies may be obtained on application to the Director, Mines Branch, Department of Mines, Ottawa, Canada.

Cellulose Films May Revolutionize Photography

CELLULOSE, the principal constituent of wood fiber, may revolutionize photographic methods by its use in photographic films. A new process has just been developed by Philippe David, collaborator of A. Bertillon, famous criminologist, by means of which it takes the place of gelatin as a support for the sensitive silver salts.

In the ordinary photographic plate of film the base of glass or celluloid is coated with a layer of gelatin in which are suspended the silver bromide particles. The gelatin layer is rather delicate, and great care must be taken with the films or plates before they are dry. Too much heat will melt the coating and spoil the picture.

With the new films gelatin and its disadvantages are eliminated. As the cellulose does not dissolve even in boiling water, the developing chemicals may be used hot to speed up the process. They may be developed in three to four minutes, fixed in two minutes and washed in 30 seconds, instead of the 15 to 30 minutes that the latter process now takes. Then they can be dried over a flame or in a hot oven in two or three minutes. The entire process, from the start of development to the dry negative ready for printing, is over in 10 minutes at the most. This is a far shorter period than can be obtained at present, and it is anticipated that the new films and plates will prove especially valuable, both for still and motion pictures, in portraying news events.—*Science Service.*

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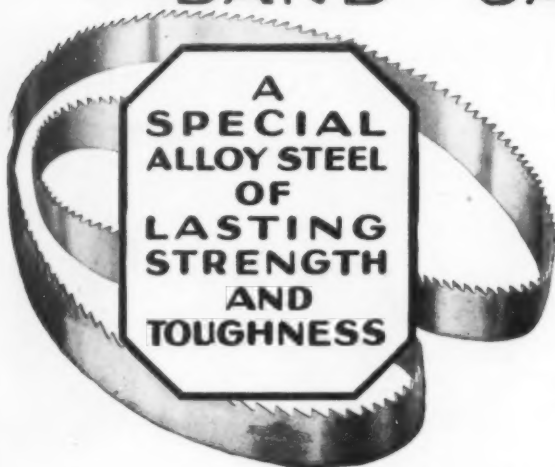
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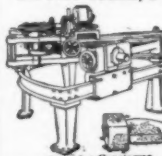
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(Continued from page 350)

used has been ideal in this duplication of ordinary wear. In suggesting a new type of service test for rubber to be applied in the laboratory, Mr. Williams said to the American Chemical Society:

"Attempts to duplicate service conditions are responsible for the existence of a large variety of abrasion machines which in the final analysis are seen to be quite similar. Each machine gives due consideration to the abrasive, the area of rubber exposed, the pressure between abrasive and rubber, and the duration of the test or the amount of slipping, apparently on the assumption that the only remaining variable is the rubber itself. The mechanical differences in the abrasion machines arise largely from the different methods employed to produce slipping between the rubber and abrasive, and from this standpoint the various machines may be divided roughly into three classes:

"1—A flat rubber surface is moved against a flat abrasive surface in the same plane. The area of the rubber exposed to the abrasive is usually maintained constant in all tests and is pressed against the abrasive by a standard pressure. The test is usually conducted for a standard time at a fixed speed.

"2—The rubber, either a prepared disk or blocks attached to the periphery of a wheel, is rotated against a rotating abrasive surface, the two axes of rotation being neither perpendicular nor parallel. The amount of sliding action between the rubber and abrasive is determined by the relative position of the two axes. The load is maintained constant while the area of contact may remain constant or may increase, depending on the shape of test piece and the relative position of the axes. The test is usually conducted for a standard time at a fixed speed.

"3—The rubber is subjected to the impact of loose abrasive. The usual procedure consists in rapidly rotating a disk of rubber in a vessel of loose abrasive.

"Abrasion seems to be the process of wearing away the surface by friction and is an action which in itself involves only the surface layer. Motion between the rubber and the abrading surface is necessary and a force must be applied to create the motion. The product of this motion and force represents the amount of work which is actually done on the surface of the rubber. The uniform conditions of surface contact, load, and amount of slip which are generally imposed on the test sample do not assure the expenditure of a uniform amount of work, which under these uniform conditions is a direct function of the resistance to motion which the rubber exerts. This factor, which has formerly been neglected, may differ as much as 100 per cent between two samples of rubber. Since the surface of the rubber can be removed only by the application of work, the measurement of volume loss on abrasion is incomplete without a simultaneous measurement of the total work expended on the rubber.

"The accompanying picture illustrates an abrasion machine proposed for measuring the volume loss of rubber per unit of work expended. The principle is that of a Prony brake in which the rubber test-pieces are made the friction surfaces of the

brake. The disk A, carrying the abra-
sive, is mounted on a hollow shaft and
rotates in a vertical plane at a speed of
17 revolutions per minute. Two rubber
test blocks, each two centimeters square
and one centimeter thick, are mounted on
the under side of the bar B, one being
placed at each end and at a distance of
four and one half inches (11.4 centimeters)
apart. The bar B is permanently attached
to a rod which extends through the hollow
shaft carrying the abrasion disk. A
weight E, attached to the end of this rod
by means of a cord over a pulley, holds
the test pieces against the abrasive. The
lever arm, C, carries at the end an adjust-
able weight which is made just great enough
to prevent the rotation of the bar B.
This weight varies from 500 to 1000 grams.
The spring balance, D, serves for the final
adjustment of the load. The abrasive
generally used is number 0 emery paper.
The abrasive surface is cleaned by means
of air jets which are not shown. Brushes
are not efficient. This machine measures
the volume loss in the usual manner which,
together with the simultaneous measure-
ment of rate of work, permits the calcula-
tion of volume loss per unit of work done."

Having discussed his new method of
measurement of abrasion resistance, Mr.
Williams goes on to consider the various
factors influencing the life of a tire in
service:

"The question of tread wear involves
much more than the abrasion resistance
of the tread stock. A tread can be worn
away only by doing work on the surface.
The work required to drive a car forward
at a definite speed and for a definite dis-
tance against the normal rolling resistance
could be determined, and this amount
of work must be done on the rear tires,
irrespective of the stock of which the
treads are composed. Work is done on
both front and rear tires due to rolling
friction. This is caused by the difference
in circumference of the tire at the center
of the tread and at the tread shoulder
which necessitates slip, and by the change
in area of the inflated tire when it de-
fects to carry the load. The amount of
work will depend on tread design with its
effect on the amount of slip, on the coeffi-
cient of friction between the rubber and
road surface, on the stress-strain relation-
ship, and on the mechanical efficiency of
the rubber. It is obvious that if the
coefficient of friction could be reduced to
zero, slipping would take place but no
work would be done. If the coefficient
of friction could be made infinitely great, no
slipping would occur and no work would
be done on the surface, but the stress due
to the strain resulting in the rubber would
be stored in the rubber in a reversible
manner. Under normal conditions both
slip and strain in the rubber result. Any
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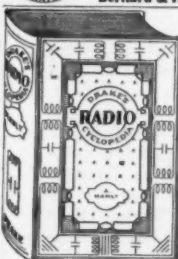


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to be minimized by dusty or wet roads which reduce the friction. While the work done on the rear tires due to driving force and on the front tires due to steering thrust must be constant for any tread stock, the work due to rolling, camber, and toe-in will vary with the road conditions and tread compound. While the present development of the abrasion machine makes possible a comparison of the abrasion resistance of any compound, it should not be expected to replace actual road tests in the selection of a tire tread."

Life of Lacquer Films

THE increasing use of nitrocellulose lacquers has induced an investigation of the effect of sunlight upon them by the Bureau of Standards. L. L. Steele reports on this investigation in *Industrial and Engineering Chemistry* in part as follows:

"Sunlight is known to be a very important factor in the decay of oil-varnish films exposed outdoors. The destructive action of sunlight, often ascribed to the ultra-violet rays, is perhaps even more marked in the case of clear nitrocellulose lacquer films exposed to the weather. In the case of the oil varnish it is probable that brittleness of the film, which causes cracking and eventual failure, is due to a slow, continuous oxidation of the drying oil originally present under the catalytic effect of the sun's rays. Lacquers do not dry through oxidation as do oil varnishes; therefore, their failure in the weather can hardly arise from over-oxidation. Their failure is probably caused mainly by hydrolytic splitting of the cellulose ester. Nitric acid is a product of such hydrolysis and would be expected to act as a catalyst in the splitting of additional portions of the cellulose ester, so that once decomposition starts it would be expected to proceed rapidly.

"The evident effect of sunlight in splitting nitric acid from the nitrocellulose in a lacquer film was indicated in the following simple experiment: To a commercial clear lacquer there was added approximately 1 percent by weight of dimethylaniline. Films of this mixture were prepared on sheets of clean steel. These films showed no appreciable coloration after several hours in the laboratory but developed a characteristic green color within five minutes when placed in direct sunlight. Photographic prints were obtained by placing a negative over one of the lacquer films and exposing to sunlight. This indicated that the green coloration was produced by light rays and was not due to a heating effect. A plausible explanation for the green coloration is that oxides of nitrogen were liberated in the film through the action of sunlight and combined with the dimethylaniline present to form the green derivative, *p*-nitrosodimethylaniline.

"In general it was found that the very strong bases, such as iso-allylamine, benzylamine, piperidine, et cetera, were detrimental in the nitrocellulose film. Many compounds appeared to have no effect on the life of the film. Urea and asparagine are in this class, but it should be noted that these compounds did not dissolve completely in the solvents present in the lacquer. Hippuric acid and oxamide appeared to accelerate decomposition although they were only partially dissolved. It is interesting to note that aniline appeared to be neutral in its effect in the nitrocellulose film while bromoaniline and especially *m*-nitroaniline appeared to have a beneficial

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effect. The greater vapor pressure of aniline might account for this difference. The most effective compound in prolonging the life of the nitrocellulose film was diphenylamine. This is noteworthy in view of the use of this material for the stabilization of smokeless powder. The brown coloration of the film containing diphenylamine caused by sunlight would probably be a serious drawback to its use as a stabilizer in commercial lacquers. Other derivatives which appeared to act as stabilizers also showed a similar defect of discoloration in sunlight."

Lubricating Oils as Insecticides

THE possibility of using oils of the type of lubricating oil in combating insect pests on plants has led to a careful investigation of this subject by E. L. Green of the State College of Washington. In reporting his results in *Industrial Engineering Chemistry*, Mr. Green concludes from studies of spraying during the dormant period, before the plants' leaves are out:

"The property of killing insects under the conditions of this study resides in a considerable range of lubricating oils, but is greatest in the portion that distills over between 240 degrees and 300 degrees, Centigrade, at 40 millimeters pressure.

"Toxicity of the kind studied does not appear to be related to the viscosity of the oils.

"The presence of significant quantities of vapor or vapor pressure is doubtful, in view of the low field temperatures and the high boiling ranges of effective oils.

"Oils for this purpose may be from asphalt or paraffin-base crude without prejudice to the effects.

"Oils that have been subjected to processes for completely removing the color are likely to be more effective than before the decolorizing treatment."

Oil "Discoveries"

SO frequent have been the reports of discoveries of oil which have had no more foundation than spillage on the surface of the ground, that the Geological Survey has issued a general statement on the subject. This statement says:

"In a large number of cases, these reports lead to local excitement and the hope that the material indicates natural occurrences of crude oil which can be developed commercially. These reports come from all sorts of geologically impossible locations. They may be in regions where the underlying rocks are Archean or granites as well as in regions where the underlying rocks are sediments not intrinsically hopeless as sources of oils.

"We believe that in practically all such cases the reported occurrences are due to contamination of the soils from filling stations or other sources of refinery products. Of course, there are a few occurrences of particularly high-grade natural petroleum which contain as much as 80 or even 85 percent gasoline, but even these highest grade crudes do not possess the chemical and physical properties of gasoline. They are likely to have a notable difference in distillation range. No cases have come to our attention in which the laboratory technician is not able to determine whether the material submitted is a fugitive distilled product or a mixture of products, on the one hand, or a natural product on the other."

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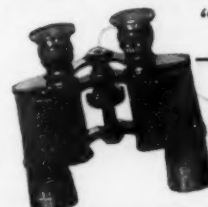
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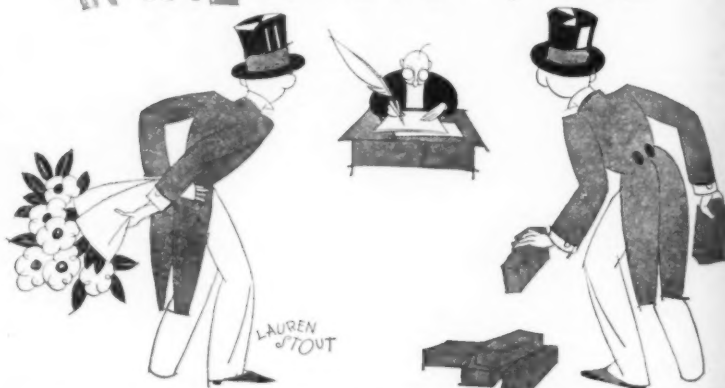
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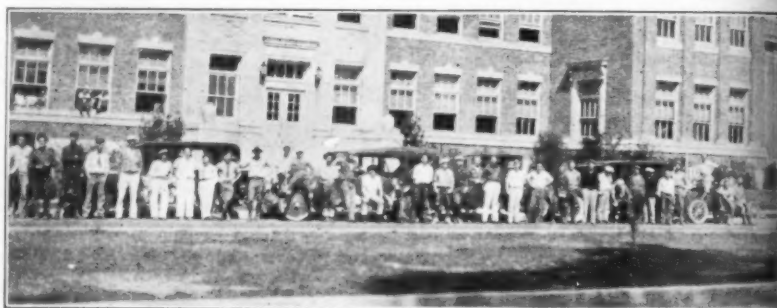


Chemistry "As She Is Taught" Out West

SEEING is believing. Those in charge of the Bakersfield, California, High School evidently understand this fact. To teach chemistry, especially where it touches on geology and mining, they get up each year a desert automobile caravan. The classes go and see things for themselves. Then they remember. This is

Classes under the guidance of R. E. Vivian frequently visit the oil wells and refineries within a few miles of Bakersfield; but the big event of the year for the chemistry students is the annual excursion of the boys to the mines in the neighboring mountains. For seven years Mr. Vivian has been piloting the boys on journeys of ever increasing length and diversity of experience.

The boys pack their own grub and



Chemistry class ready to start from Bakersfield High School

real education, not merely "book learning." But let Mr. Mark Wilcox of that community tell it:

Editor, SCIENTIFIC AMERICAN:

Here is one chemistry class that has a chance to realize how chemistry in some of its phases may affect the lives of many people in the community. Bakersfield High School, in the center of one of the richest oil and mineral regions in California, has as its instructor in Junior College chemistry a man who is both an expert in petroleum technology and the county assayer of minerals.

blankets and sleep on the ground; they enjoy playing the part of seasoned prospectors. Memories of personal adventures in the observation of mining processes are brought home by the boys, and they will doubtless remember them long after the tame experiments of the laboratory have been forgotten.

When it was announced this year that the trip was to be more extended than ever, all the boys wanted to go. They were to visit the mines in and around Death Valley and would be gone at least four days. Each boy would have to provide his own means



Old borax wagons in Death Valley, abandoned for railway and motor trucks

of conveyance, of course, and this requirement eliminated several. But at last over 40 boys assembled in all sorts of cars from little strip-downs to seven-passenger sedans. Thirteen cars—some caravan!

What did they see? They saw gold ore, of course. After all these years since 1849 there is still gold to be found in paying quantities in the mountains of California and the neighboring state of Nevada. With the gold they also saw silver and lead and zinc. The boys were surprised to learn that these metals are usually found together in the same ore although in different proportions and chemical combinations. In the famous old Yellow Aster gold mine, for example, much silver is recovered. At the California Rand silver mine, on the other hand, which has taken millions of dollars' worth of silver out of deep holes in the ground within the last ten years, thousands of



One of the students examining specimens of ore in Darwin mine

dollars worth of gold is also annually extracted.

What they really saw, of course, was a white or reddish white rock with peculiar dull blue or yellow streaks in it. They had to take Mr. Vivian's word for it that they were looking at gold or lead or silver ore! But after they had been through the huge concentrating mills at Darwin and at Randsburg, and had seen how this streaked rock was ground to a powder and mixed with water to form a grayish, pasty-looking mud, before the precious metals could be recovered by further intricate processes, they began to realize that gold mining is no occupation for a poor man. As one boy naively remarked, "I can see now, Professor, why gold costs so much!"

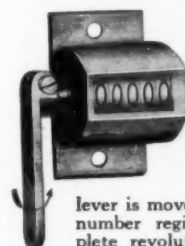
They also visited a soda plant, where the waters of an alkali lake are turned into baking and washing soda, and they saw on the eastern side of Death Valley the great borax mines and mills of "Twenty-Mule Team" fame. As this was an educational trip they wanted to visit as many different types

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of mines as possible while on the trip.

One of the requirements for participation in this great adventure was that each boy should report to his chemistry teacher what he had gained. All of them dwelt, over-much, perhaps, on the good time they had had roughing it. But a few of the older boys were able to express clearly some of the lasting impressions they had received.

"The trip helped me to understand many things better," said a reflective boy. "More can be learned by seeing a thing actually done than by reading about it. Also this trip was a great experience in cooking and learning how to live."

"The trip was sure great," wrote another. "I learned about some of the geology of the country we passed through and about processes used in the mills we visited. But I believe that I will remember the trip best because I learned first hand the secret of the desert country—of the charm of its vast desolations that is dreadfully forbidding unless one comes willing to appreciate its sombre beauty."

Another boy who is a "shark" at chemistry and whose report bristled with chemical formulas concluded with this inspired outburst: "I would give most anything for a picture, colored naturally, of the Mojave Desert as we saw it. The view was always changing. At one spot we would be in a flower bed, a blaze of blue and gold and yellow; a few miles farther on in a wonderful velvety green; and yet a little farther, nothing but desolate sand covered with greasewood and cactus. From the floor of Death Valley in the center of an awful waste of sand and shimmering heat waves, we could see the peak of Mt. Whitney, the highest spot in the United States, and that peak was covered with snow. Yes, it would be worth taking the trip to see the scenery alone."

Looking after so many carloads of boys was quite a task, Mr. Vivian admits; but thorough organization and careful planning made it comparatively easy. At every fork in the road, for example, where there was a chance of any one going astray, Mr. Vivian would wait or have one of the older boys wait until every member of the party had passed. Each machine carried extra gas and oil and water, and they were all expected to keep together in order to help each other in case of need.

Whether they remember anything about mines and mining these lads will know better how to handle themselves in desert country, if they ever want to try it again.

Mark F. Wilcox.

The Bee Comes to the Aid of the Telescope Maker

THE editors fully anticipated as they began their telescope-making campaign 18 months ago that when several thousand SCIENTIFIC AMERICAN readers were turned loose on certain of the problems involved in this work, one or more of them would discover some new and valuable basic principle. And so it has turned out. In the following communication Mr. Russell W. Porter of Springfield, Vermont, who has closely collaborated with our staff in helping make a success of the amateur telescope-making campaign, releases to the amateur fraternity the latest secret:

Editor, SCIENTIFIC AMERICAN:

At a recent convention of amateur telescope enthusiasts held at "Stella-fane," Springfield, Vermont, an en-

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tirely new technique of polishing their mirrors was brought to light that will prove a great boon to the large and increasing body of young men in this country devoted to the making of concave mirrors for reflecting telescopes. I have given the method a thorough tryout and find it has several advantages over the time-honored process of polishing on a lap of pitch.

Newton, in the 17th century, found that properly tempered pitch served admirably for a bed on which a finely-ground glass surface could be brought to a complete polish, and it is still used for polishing and figuring optical surfaces, such as lenses, prisms, flats, et cetera. However, making a pitch lap is somewhat of a trial to the amateur and has been adequately described as a "mussy" job.

It is here that the humble bee comes to the rescue. Apiarists are now using what they call a "comb foundation" which they place in the hives. On this the bees build up their honeycombs. This foundation is an artificial sheet of pure beeswax whose surface is covered with a network of small hexagonal depressions. Its thickness varies, but averages about a sixteenth of an inch. If one of these sheets of wax is now spread over the glass tool of the mirror maker, he has a lap ready for polishing and can forget his pitch entirely.

My first surprise on trying this novel polisher was the perfect uniformity with which the glass began to polish. It would seem that the structure of this comb foundation provides a cushioning effect that gives uniform contact with the glass from the start. The tiny wax partitions making up the hexagonal pattern slowly spread under the pressure and heat of polishing, accelerating the polish as the work progresses.

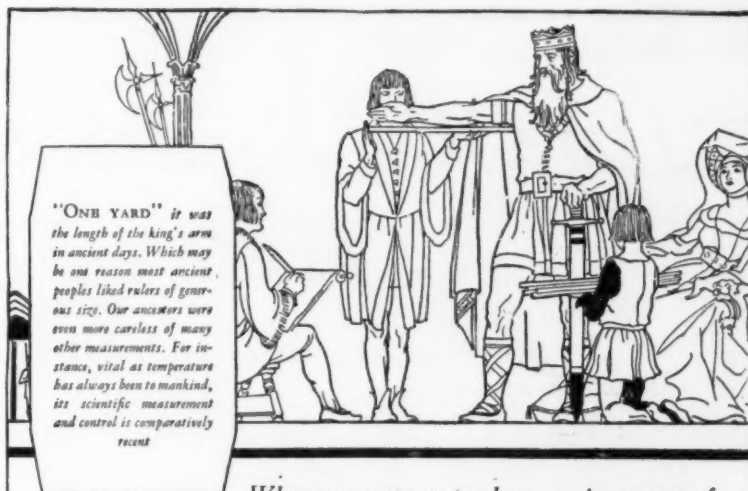
As the last pits disappeared from my test disk (five inches in diameter) I looked at the clock and was astounded to see that the glass had been brought to a complete polish in about two hours. When it is understood that seven to nine hours are usually required to polish on pitch, no further comment is necessary.

When the speculum maker has polished his mirror he "figures" it; that is, he laboriously wears away parts of the glass until it reaches a surface of revolution known as a paraboloid. To accomplish this, certain parts of the pitch lap are cut away in order to bring the abrading action upon the part of the glass where it is needed. For the amateur this means perhaps that he must make over his lap several times, each time going through the "mussy" job previously alluded to.

With comb foundation, however, any desired lap may be cut out and used, stripped off the tool and another quickly substituted. The sheets adhere readily to the tool if the tool is first smeared with turpentine and any excess wiped off. The sheets come in rectangles seven by 14 inches and cost about 12 cents apiece. I had no difficulty in obtaining them of a bee keeper in my community and I imagine they are equally available elsewhere. For mirrors over seven inches diameter, two sheets may be joined, or butted, and a lap built up to any size required. Moreover, they may be built up one upon the other to any desired thickness.

Withal, no better medium could have been designed for convenient and efficient mirror polishing than this product of the bee keeper.

Incidentally we must thank such gatherings as the one held at "Stella" [See mention of this meeting in Digest department—Editor] for dis-



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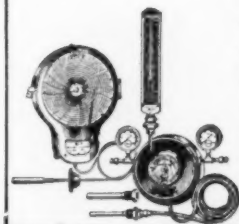
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Here Was Something We Hadn't Figured On

"The Scientific American is harder to get than it used to be," a good friend of ours told us recently.

This surprised us. We had redesigned our magazine to make it easier to find. Our greatly increased sales seemed to justify the innovation. We determined to investigate. At a news-stand in a certain railroad station we found the answer.

"My sales of Scientific American used to average twelve a month," the dealer told us. "You see, my stand is so constructed and so situated that I couldn't display the Scientific American, and it got sold only to those people who came up and asked for it. When the July number came out, however, it was a smaller size and I was able to place it where people could see it. I sold twenty-five in two weeks. Of the August number I sold thirty-four. For September I have ordered fifty and I will sell every one of them."

"But how about this complaint that the Scientific American is harder to get now?" we asked.

"It's sold out sooner," he replied. "Your friend went to some stand too late. He'll have to go early after this if he wants to be sure of getting the Scientific American."

Our friend had a better solution. He took out a year's subscription to make sure he would not be disappointed.

A good idea! Why don't you do the same and insure getting your favorite magazine early, regularly, surely every month? Here is a special offer coupon that will make it easier for you.

The regular price is \$4 for twelve months. Send this coupon with your check for \$4 and you get the Scientific American not only for the twelve months of 1928, but for the remainder of this year as well—fourteen months for the price of twelve.

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seminating and making available information such as the above.

Finally, the person to whom we are directly indebted for this method of glass polishing is Mr. A. W. Everest of Pittsfield, Massachusetts. Mr. Everest brought with him to "Stellafane" a ten-inch mirror which underwent a gruelling examination on test objects, and although the seeing was only fair, it stood up beautifully with his quarter-inch ocular, readily resolving the components of *Epsilon Lyrae*.

R. W. Porter.
"Stellafane," Springfield, Vermont.

Cavalry Colonel Makes Reflecting Telescope

THE recent publication of the SCIENTIFIC AMERICAN book "Amateur Telescope Making," containing instructions for making several types of medium sized reflecting telescopes (also lists of manufacturers from whom the materials may be purchased) seems to have awakened ever spreading interest in this fascinating work. Here is a short letter from an army officer who has evidently completed his telescope



Colonel Moffet and his home-made telescope. The two axes are old Ford axes, the brake drums being used for the setting circles

and is satisfied with it. Such an instrument will magnify 100 diameters.

Telescope editor, SCIENTIFIC AMERICAN

Your kind note regarding the telescope merited an earlier reply, but I did not have the photograph and weather conditions were not favorable. But here is one. I doubt if you will care to use it, as there is very little originality in the job. I followed directions pretty generally. While the mirror is clearly not perfect, it is wonderful what it will bring to sight in the heavens. Have not purchased any mirrors or lenses, but made diagonal and eye-pieces myself. Probably will get even better results when I see fit to buy better accessories.

The entire cost of reflector and mounting complete was just about 50 dollars. I was rather surprised that it could be done for that sum, as that was the proposed expense for the simple wooden mounting.

W. P. Moffet,
Lieutenant Colonel, Cavalry,
United States Army.

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By Saxton Pope.

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HISTORY OF THE INCANDESCENT LAMP

By J. W. Howell and Henry Schroeder.

Probably no single invention has affected modern progress and comfort more than Edison's discovery of the vacuum bulb electric light. It is eminently fitting therefore that all the facts in connection therewith be recorded while the correct and accurate data are obtainable. This has been done by the authors in a most interesting manner.

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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

CONDUCTED BY MILTON WRIGHT

Co-operation Among Inventors

LIKE other birds, inventors sometimes exhibit a tendency to flock together. Their object is mutual aid in protecting, developing and promoting their inventions. An effort to effect such co-operation is suggested by one of our readers in the following letter:

"Many an invention has never been brought to a successful conclusion—many an invention has not gone any further than just being thought about—many has died with the death of its inventor—all because there has been a lack of funds for experimenting, for testing and for perfecting the idea.

"Would you approve of a banding together of men with ideas to overcome obstacles? Would you assist these same men in co-operating to carry out their ideas in accordance with the following plan?

"Each inventor interested in this project would pay a fee of 100 dollars for a life membership. The money thus raised would be used for leasing property to be used as a laboratory, machine shop, drafting department, club room and other facilities. Each member would submit his idea for approval to an Advisory Board for criticism and recommendations for improvement. The inventor would also submit 'a bill of material' which would be filled from the supply of the organization at cost. The member would then be allotted a time for using the machine shop, drafting room or laboratory of the organization, and in the course of his experiment, questions or difficulties which might hamper the successful conclusion of his work would be submitted in writing to the Advisory Board which would render to him any service it would deem best.

"The organization would become self-supporting after a number of members had successfully marketed their inventions, for a stipulation would have been included in the membership agreement, providing that a certain percentage of moneys received from the sale or lease of patents or patented articles would go to the organization.

"Any assistance you can give me or anything you can do to start publicity for the formation of such an association of inventors would be deeply appreciated, not only by the writer, but I believe by the numerous persons whom it would affect."

Such an undertaking as Mr. Rogen suggests is interesting and praiseworthy. There have been organizations which, on the face of them, seem to be very much like the organization in mind. Most of them, however, were fake concerns whose principal object seemed to be to make as much money as possible out of inventors. A real honest-to-goodness organization, such as he plans, might be feasible, but there is this theory which would tend to work against it:

An inventor usually is interested in his own invention and in nobody's else. The

mere fact that he lacks equipment in perfecting his idea generally is not an obstacle. In fact, one of America's most distinguished inventors told us recently that he considered it a decided advantage for an inventor not to have too much equipment at his command. Not only is each inventor not interested in other inventors, but he is likely to look upon the inventions of others as impractical or at least not as valuable as his own. As a matter of fact, many inventors who would join such an organization would be men with impractical ideas.

Refusals do not Imply Lack of Merit

HOW many an inventor there is whose invention is turned down by a big corporation, but meets with success when the inventor promotes it himself! Such is Samuel S. McKnight, who has just won a victory in the courts over the D. B. A. Burns Bottling Machine Com-

pany for the infringement of his patent.

McKnight invented a crown feed for an automatic crown bottling machine and obtained a patent which contained only one claim. He offered his invention to the Crown Cork and Seal Company, but the company declined it. At this time Burns was foreman of repairs for the company. Soon afterwards Burns left and founded a concern for the repair of crown bottling machines. Later, when rebuilding certain machines, Burns installed in them an improved means for delivery of the crowns. It was substantially similar to McKnight's in most respects. McKnight sued the Burns Company for infringement.

Of the value of McKnight's single claim Judge Soper in the Maryland Federal District Court says:

"The evidence proves not only the novelty but the utility of the device in a crowded art. Troublesome difficulties and delays in the delivery of crowns in

Patents Recently Issued

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Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

WING STRUCTURE FOR AIRCRAFT—Which enables aircraft having two, or more, superposed wing surfaces, to vary the surface angles, with the result that the flying speed can be varied, at constant engine speed. Patent 1628625. A. Tammeo, c/o G. Capuccio, Via Arsenale N. 17, Surin, Italy.

AERIAL RAILWAY—In the form of a monorail vehicle which may be quickly loaded and unloaded, and readily turned to reverse its direction especially adapted for short runs. Patent 1636619. F. P. Archer, 107 No. Franklin St., Wilkes-Barre, Pa.

Pertaining to Apparel

GARMENT—A diaper cover, of water-proof material slitted from the waist band, providing a ventilating opening and permitting the cover to be readily placed on a child. Patent 1627771. J. H. Dwork, c/o Red Raven Rubber Co., 153 Sussex Ave., Newark, N. J.

TIE—So constructed that no matter how much subjected to tension, it will resume its normal position when released, and will not lose its shape. Patent 1635946. H. B. Mapou, % J. M. Green Co., 7 E. 20th St., New York, N. Y.

SHOE LACE—Wherein elastic lacing members are used simulating ordinary laces, and interlocking metal members are provided for holding the front of the shoe together. Patent 1635884. M. K. Gilewicz, 600 E. 139 St., New York, N. Y.

Chemical Processes

FIREPROOF COMPOSITION—For materials on walls, of such consistency that it may be sprayed, the composition comprises of a mixture of asbestos, flour, lye, and salt dissolved in water. Patent 1628171. A. McIntyre, 2510 So. 2nd Ave., Billings, Mont.

TREATING HYDROCARBON OILS—A process whereby hydrocarbon oil is passed through heating coils, vaporized, and when free hydrogen introduced for the production of water white oil of the gasoline series. Patent 1628532. W. L. Coultas, Jr., Scaford, N. Y.

Electrical Devices

GAS IGNITING DEVICE—An electric gas lighter, using the ordinary house lighting current, or a battery current, designed for automatically igniting a gas stove when the burner is turned on. Patent 1635104. S. J. Woods, 10 Burdick Ave., Newport, R. I.

PROCESS AND APPARATUS FOR RECHARGING MAGNETS—Especially designed for recharging magnets that form part of magnetos, at a minimum cost of electrical energy, and while the parts are in their normal position. Patent 1636941. S. V. Losey, 8745 Dunbarton Rd, Detroit, Mich.

TELEGRAPH TRANSMITTER—Movable a relatively short distance for interruption of the circuit to transmit dots, and a slightly longer distance in the opposite direction in the transmission of dashes. Patent 1627819. J. R. Youngblood, 1622 Dublin St., New Orleans, La.

existing automatic capping machines were obviated and mechanical parts were eliminated. Practical success was achieved in a number of factories under the supervision of the patentee and also in the machines equipped with what we shall see to be the infringing device of the defendant."

After comparing the two machines the court grants an injunction against the Burns Company.

Trademarks in Translation

WHEN a German firm some time ago applied in Japan for registration of the trademark "Purit" the Examiner refused to register it because of the prior registration of "Flit" by an American firm for the same class of goods. Only after a vigorously fought appeal was the mark registered over the Examiner's objection that the words are deceptively similar.

The similarity lies in the fact that when the two words are translated into Japanese, "Purit" is spelled "Fu (with a dot)-ri-t-to" and "Flit" becomes "Fu-ri-t-to." All of which goes to show that a trademark which may be pie in one country is applesauce in another.

Where Delay Proved Fatal

DELAY in applying for a patent often is fatal. Such has proved to be the case with Cortlandt F. Flake whose application for a patent, after going through the Patent Office, finally has been denied by the Court of Appeals of the District of Columbia.

The invention in question relates to a method of preserving fresh citrus fruit by treating it with a thin coating of paraffine dissolved in gasoline or some other volatile solvent of paraffine. Prior to the invention, citrus fruits when being prepared for market were mechanically brushed with paraffine as a means chiefly of preserving their color, but were not so coated as to preserve them in a fresh condition.

In the winter of 1915-16, Flake was employed in a Florida fruit-packing house, and one of his duties was to adjust the blocks of paraffine so that the polishing brushes would take up sufficient paraffine to polish the fruit as it passed them.

Flake alleged that the difficulties of this operation led him to dissolve the paraffine in gasoline and pour the solution upon the polishing brushes, and that as a result of this experience he conceived the idea of using such a solution for coating the fruit. The testimony discloses that Flake experimented along this line, and disclosed the subject to others.

Meantime, Rex de Ore McDill conceived the invention and reduced it to practice in October, 1920. He moved promptly to bring the invention into use in the citrus industry in Florida and on January 12, 1921, he applied for a patent. By a mistake he used the word "petroleum" in his application instead of "gasoline," but the circumstance showed his promptness. He made a new application in November of the same year.

In the season of 1921-22 Flake bought some of McDill's preparation and used it, but it was not until March 1, 1922,

SOLENOID MOTOR—In which the interruption of current in the solenoid, by reason of the actuation of a plurality of armatures, produces power which can be made use of. Patent 1635-935. A. F. Godefroy, 3506 Olive St., St. Louis, Mo.

ELECTROMAGNETIC RELAY—Particularly adapted to uses in pipe organs, the contacts being mounted in a novel manner, their removal leaving other parts undisturbed. Patent 1636609. A. A. Klann, Waynesboro, Park Station, Va.

COUPLING—An automatic coupling which includes mechanical coupling members dependent for their effective action on the holding power of an associated electro-magnet. Patent 1635-144. W. G. Stevens, Jr., 100 W 55 St., New York, N. Y.

NON-RESONANT DIAPHRAGM—Adapted for use in electric microphones and receivers generally, permitting the tone values to be transmitted in an extremely natural manner. Patent 1637243. E. Reisz, c/o Messrs. Fehlert, Loubier, Harnser and Buttner, S. W. 61 Belle Allianceplatz 17, Berlin, Germany.

Medical and Surgical Devices

DIAGNOSTIC DEVICE—To record the difference in temperature between healthy tissue and organic inflammation of interest to physicians, surgeons and diagnosticians. Patent No. 1622887. William Smith, 53 South Broadway, Yonkers, N. Y.

MASSAGING DEVICE—Which may be adjusted to cause the rollers to engage the flesh with a kneading or fingering action, for effecting increased circulation. Patent 1631792. W. B. Burnley, 6533 Meridian St., Los Angeles, Calif.

BONE CLAMP—An instrument with which the two sections of a broken bone may be held in properly aligned position, until the ordinarily used plaster cast hardens. Patent 1635137. C. E. Mullens, 99 Washington Ave., Albany, N. Y.

Musical Devices

MUSICAL INSTRUMENT—A wind instrument of the all-metal type, in which vibrating reeds or similar devices are eliminated, played in the manner of a harmonica. Patent 1631862. W. Hansell, 33rd & 3rd Ave., Brooklyn, N. Y.

BANJO—With novel means for causing the tone to have a clear, metallic ring, and for setting free the sound waves by a sound reflecting member. Patent 1631293. H. H. Slingerland, c/o Slingerland Banjo Co., 1815 Orchard St., Chicago, Ill.

HARMONICA—An attachment for harmonicas of conventional construction, having means for controlling the volume of music, also serving as a handle for supporting the instrument. Patent 1637289. W. B. Yates, Maniton Colo.

CIPHERLESS DEVICE FOR PIPE ORGANS—By means of which an entire chest may be thrown out of action should one of the pipes in said chest continue to sound, thus producing a cipher. Patent 1632657. G. H. Kloehs, c/o United States Pipe Organ Co., Crum Lynne, Pa.

Of Interest to Farmers

COTTON PICKER—In which the drums have radial picking fingers driven by novel constantly meshing gears, easily controlled, doing away with belts and pulleys. Patent 1635161. H. N. Berry, c/o H. A. Gamble, Greenly Bldg. Greenville, Mississippi.

Of General Interest

CHECK PROTECTOR—A device included in an ordinary pocket knife, for roughening a portion of the paper after writing a check. Patent 1631863. R. I. Harris, Punta Gorda, Fla.

that Flake applied for a patent. He alleged conception, reduction to practice and disclosure as early as January, 1916. In denying his application and awarding priority to McDill, the court, Chief Judge Martin writing the opinion, declares:

"The examiner of interferences held upon the evidence that Flake's experiments were not regarded by him as a reduction to practice, but were desultory, and in legal contemplation were abandoned experiments; that he did not show diligence from October, 1920, when McDill entered the field, until his (Flake's) filing date; and that he is not entitled to prevail.

"We agree with this conclusion for the reasons stated by the examiner, which need not be further repeated here."

Inventions for Uncle Sam

"CAN you advise me how I can get in touch with the man who handles inventions for the government? I have an invention which is of no use to anyone except the government itself. I know it is practical and I have seen where it is needed. After seeing how much money is lost because of the lack of such an invention as mine, I am convinced that this invention will save the government approximately, 1,000,000 dollars every three to five years."

So writes an inventor to the editor of this department. What his invention is he does not say. His letter will serve, however, as a text for a little discourse on a phase of marketing inventions about which many inventors are a bit hazy.

There is no individual, committee, bureau or agency whose purpose is to accept inventions generally on behalf of the government. As a rule, the government does not buy inventions. There are a few exceptions to this rule; such an exception might occur in the case of a new type of anti-aircraft gun or a piece of apparatus used in the manufacture of paper money—cases where it would be desirable to prevent others from using the invention.

Usually, however, the government has no interest in acquiring a patent. This we believe, is entirely logical. Let us assume that the invention in question is a stamp-cancelling machine which would save the post offices many thousands of dollars yearly. The Postmaster General, we will say, has seen it and wants it installed in his offices throughout the country. Should he buy the patent? He should not.

A patent is a monopoly. It gives to the owner the right to prevent other persons from making, selling or using the invention to which it applies. The government is not interested in preventing others from benefitting themselves or their businesses. The stamp-cancelling machine might be adapted to cancelling checks in a bank. The government would not want to prevent the banks from performing a necessary operation more cheaply and efficiently.

Does this sound discouraging for inventors? Not at all. The government buys equipment from manufacturers. Sell your patent to the manufacturer or lease it to him on a royalty basis. He gets his profit from the government; the inventor gets his share from the manufacturer. It works out just as well for the inventor as if the government purchased the intangible patent rights from one person and the article itself from another.

EXTENSION-LEG ATTACHMENT FOR LADDERS.—For supporting a ladder firmly on a level surface, or to prevent slipping on an inclined or irregular surface of a roof. Patent 1631513. F. F. Berry, Box 437, Concord, N. H.

BALE-BAND BUCKLE.—Especially adapted for use in firmly and securely holding bands around cotton bales, but also adapted for tying bands around other commodities. Patent 1631402. T. J. M. Daly, c/o S. E. Compress & Warehouse Co., Atlanta, Ga.

SPRING CLIP BINDING POST.—One operation manufacture. Takes all Tips. Wires inserted with one hand. Not necessary to sever continuous leads. Patent 1598003. B. A. Parrott, 73 Orchard Park Blvd., Toronto, Canada.

CIGARETTE CASE.—Which can be stamped with one die, from one piece of leather or metal, adapted to form a case as well as holder for lighter. Patent 1628590. D. W. Greene, c/o Max E. Bernhardt, 127 W. 30th St., New York, N. Y.

BOTTLE-STOPPER SEAL.—Wherein means are presented for destroying the label before the stopper can be removed, and positively indicate that the bottle has been opened. Patent 1628555. H. G. Pepino, 235 Ditmars Ave., Astoria, L. I., N. Y.

WIG FOR DOLLS.—The principal part of which may be formed from a straight flexible structure capable of being distorted until it fits the head. Patent 1628591. P. Harris, 102 Wooster St., New York, N. Y.

CIGAR CUTTER.—Comprising a receiving member, and a cutting or perforating member, which automatically functions to cut the cigar end. Patent 1628570. T. H. Anderson, c/o Max E. Bernhardt, 127 W. 30th St., New York, N. Y.

COFFEE-POT.—Of the percolator type, which operates to percolate and simultaneously filter the coffee, preventing burning of the finer grains, and leaving a greatly clarified liquid. Patent 1624606. F. E. Lane, 1357 9th St., Douglas, Arizona.

SUPPORT FOR GARMENT HANGERS AND THE LIKE.—In the form of a bracket, particularly suited for attachment to bent poles or other locations where nails might be undesirable or damage the pole. Patent 1628623. L. Jonnes, Circleville, Ohio.

MORTAR-APPLYING DEVICE.—Designed to facilitate the manual application of mortar to the connecting ends of pipe sections, particularly pipes for irrigation purposes, forming a liquid-tight joint. Patent 1626972. A. H. Sanders, 342 North Vista Bonita Ave., Glendora, Calif.

INK DISPENSER.—For printer's ink, effectively protecting the ink against evaporation when not in use, and manually operable to dispense ink in any quantity. Patent 1632473. W. R. Greenland, 2054 Cambridge St., Los Angeles, Calif.

CRATE.—A crate structure having a slatted bottom, and a hanger and brace element which rigidly support the bottom in proper position to the body. Patent 1635133. J. F. Maurer, Jr. Woodcliff, North Bergen, N. J.

MONOGRAM.—Made up of separate letters readily association to constitute an apparently solid monogram, without special skill or special tools, adapted for automobiles, or other uses. Patent 1635077. J. E. Erskine, 21st St. and Talleyrand Ave., Jacksonville, Fla.

LINE PULLEY.—For clothes lines, formed of rust-proof materials, and mounted in a cylindrical housing ready for use at all times. Patent 1635145. A. W. Taylor, 626 Jenkins Ave., Peachville, Pa.

SPRAY.—The fluid supply pipe forming a trap in which a supply will be maintained, thus saving power, the device may be used for liquid or powdered insecticides. Patent 1635069. A. G. Bulle Villegas 23 Y 25, Havana, Cuba.

DISPENSING-CONTAINER SEALING DEVICE.—Having means for preventing suprious refilling, whereby when the seal has been broken a special closure plug prevents spilling of contents. Patent 1635122. C. D. Henriques, 52 Chatsworth Ave., Larchmont, N. Y.

OVERJACKET FOR MOLDS.—Intended to be fitted over a sand mold after removal of the usual flask to prevent bursting out of the molten metal. Patent 1635074. A. Diehl, c/o G. B. Smith, Atty, 407 Bushnell Bldg., Springfield, Ohio.

WINDOW SEAL.—For preventing the entrance of cold air, or dust between the meeting rails of the sashes, and between the sashes and the frame, without weather strips. Patent 1635076. A. C. Enoch, 401 Scott Thompson Bldg., Oklahoma City, Okla.

Hardware and Tools

GUTTER HANGER.—For supporting gutters adjacent the roof, by not only embracing the gutter bottom exterior, but for straddling the top of the trough. Patent 16622 (Reissue) C. Meunier, c/o C. A. M. Mfg. Co., Great Neck, L. I., N. Y.

FUR STRETCHING AND NAILING DEVICE.—A portable device for effecting the stretching and nailing of the fur, or skin, to conform to the outline of a coat pattern. Patent 1628588. S. Friedman, c/o Reliable Machine Works, 238 Eagle Ave., Brooklyn, N. Y.

DOOR-HOLDING DEVICE.—For holding doors and similar closures in open or partially open position, may be swung to and fro and secured in inactive position when not in use. Patent 1626007. C. B. Mitchell, 5019 1/2 Noneta Ave., Los Angeles, Cal.

EXPANSIVE DRILL BIT FOR CABLE TOOLS AND THE LIKE.—Which may be operated as an underreamer for reaming a hole already drilled under a casing to such size that the casing will freely pass. Patent 1637268. J. P. Miller, Houma, La.

ELEVATOR.—A grapple or lifting hook for hoisting rods or other objects, securely holding them although they may be easily associated with, or taken from the device. Patent 1637209. B. Woods, Holdenville, Okla.

RATCHET DRILL.—Which can be operated in a place of a relatively slight area, and can be adjusted to turn the tool in either of two opposite directions. Patent 1635882. H. W. Barbour, New Bern, N. C.

Machines and Mechanical Devices

DIES.—Especially adapted for Beveling Angles and Flanging Plates and Bars COLD, can be fitted to Punching Machine or Hydraulic Press. Patent 1633744. Geo. Hughes 411 Palmer Ave., Maywood, New Jersey.

DEVICE FOR FINISHING CONCRETE SURFACES.—For rolling flat surfaces in such manner that the coarse material is forced below, enabling the surface to be smoothly finished without extra top layer. Patent 1623142. C. S. Walsh, 537 Progress Peace, Los Angeles, Cal.

AUTOMATIC BELT GUIDE.—With novel automatic means for returning the belt to a central position should it move sideways no matter which direction the conveyor is running. Patent 1628615. B. Ross, 6219 Kenwood Ave., Chicago, Ill.

OIL PUMPS.—Having two or more pumping units operating in such a manner as to prevent sand or other solids from settling in or on the valves. Patent 1625031. L. P. Kesselman, 205 La Verne Ave., Long Beach, California.

COUNTERWEIGHTED SIDEWALK ELEVATOR.—For hoisting ashes or transferring merchandise from the sidewalk to a basement, may be entirely operated by one man, automati-

cally locking against accidental movement. Patent 1628556. A. J. Rosell, 205 So. Oxford St., Brooklyn, N. Y.

MULTIPLE BENDING APPARATUS.—Especially designed for the double bending of reinforcing rods used in cement structures, adjustable for varying the configuration of the bends. Patent 1628581. F. J. L. Dinkel, 817 Madison Ave., North Bergen, N. J.

TRY COCK.—Which combines means with the appurtenances of a cock for preventing accidental separation of the valve control and parts connected herewith. Patent 1628566. W. E. Williams, 62 Front St., New York, N. Y.

PACKING RING.—Capable of contractile adjustment so that the ring works constantly on any or all points of the periphery of a rod. Patent 1631654. O. Stoffel, c/o Wm. Paterson, 311 35th St., Woodcliff, West New York, N. J.

FABRIC-TESTING MACHINE.—With means for subjecting a piece of fabric to frictional action so that comparative tests as to wear-resisting qualities may be made. Patent 1632591. C. L. Dennis, 41 Union Square, New York, N. Y.

CHANGE-RETURNING DEVICE.—Operable by the pressure of a button indicating the number of units sold, and a second button indicating the amount of money deposited. Patent 1631326. L. B. Nordlund, 1095 Mission St., San Francisco, Calif.

COMBINED COAL STOKER AND BURNER.—Which affords facilities for feeding coal to the flame in a furnace at regular intervals, and for supplying air, and supporting the burning fuel. Patent 1633465. J. C. St. Clair, 313 W. Granite St., Butte, Mont.

COIN-CONTROLLED LOCK.—For application to a door of a pay-as-you-enter compartment, when the compartment is in use the last coin inserted is visible. Patent 1633411. F. W. Kassler, 1343 Bayard Ave., St. Louis, Mo.

DITCHING MACHINE.—For cutting temporary irrigation ditches of any desired width or depth, and forming a plurality simultaneously, and shaping the ditches to required contour. Patent 1632303. J. G. Lindeman, 119 So. First St., Yakima, Wash.

DISPLAY SIGN AND METHOD OF PRODUCING THE SAME.—The device may be used to display pictures having the effect of movement either in part, or in whole, in show windows or out of doors. Patent 1634174. S. Cornett, Reece, Kans.

COAL-SPOUT-OPERATING DEVICE.—Which automatically moves the down spout of a coal bunker through an oscillatory path over the feed trough of a boiler, furnace or the like. Patent 1633914. G. M. Wutzler, 34 So. Elmwood Ave., Waukegan, Ill.

SAWMILL NETWORK.—For use in connection with saw mill carriages, in adjusting the knees or head blocks so that the saw will cut a log of any desired dimensions. Patent 1633206. T. Carmichael and J. E. Bowlin, Box 575, Fort Bragg, Calif.

SACKING, PACKING AND MIXING MACHINE.—Wherein molasses is mixed with cotton seed hulls, or ground hay, during the packing operation, in such manner as to thoroughly incorporate the molasses and other material. Patent 1635936. M. Gotten, 2233 Flarbert Ave., Memphis, Tenn.

LIQUID-MEASURING ATTACHMENT FOR TANKS.—An attachment adapted for use in subterranean storage tanks by which the amount of liquid can be determined without the necessity of lowering measuring rods. Patent 1634608. J. E. Boegen, 1652 West Washington Blvd., Los Angeles, Calif.

LATHE CHUCK.—In which the jaws of the chuck are moved simultaneously by a handle, giving greater gripping action than the ordinary

type, yet instantly releasable. Patent 1635481. V. G. Jorner, 2719 Hampden Court, Chicago, Ill.

Prime Movers and Their Accessories

ROTARY ENGINE—Including a plurality of arcuately shaped cylinders operated through oscillating arms, the arms in turn being controlled by oscillating levers carrying rollers that move in cam tracks. Patent 1628162. J. A. Lehnert, Howard, S. D.

ARRANGEMENT FOR HYDRAULIC INTERNAL-REACTION PROPULSION—For ship propulsion, by the reaction of water contained within propelling tubes and flowing out of them under the action of compressed air. Patent 1631783. O. Angelini, c/o Barzano & Zanardo, 9 Via Due Marcelli, Rome, Italy.

CHARGE-FORMING DEVICE FOR INTERNAL COMBUSTION ENGINES—Especially designed for use on motor vehicles, to increase the mileage per gallon of gasoline and decrease the formation of carbon in the engine. Patent 1631362. E. C. Colliard, Arcade, N. Y.

SPEED-REDUCTION MECHANISM—Interposed between the main crank shaft and counter shaft of an internal combustion engine for controlling the operation of the rotary valve. Patent 1631739. A. J. Krause, 1408 E. 25 St., Cleveland, Ohio.

SPARK PLUG—Which affords means for readily disassociating the parts for the purpose of cleaning and renewing, and reduces to a minimum the formation of carbon. Patent 1633435. E. N. and F. O. de Alcocer, c/o F. O. de Alcocer, 2418 Ellendale Place, Los Angeles, Calif.

ENGINE VALVE—Which is noiseless in operation, will eliminate tappets and springs, increase the efficiency of the engine, and eliminate the necessity of regrounding. Patent 1633694. A. E. Colchester, 59 King St., Dorchester, Mass.

ROTARY VALVE—With a packing ring diagonally arranged around the valve cylinder and extending across the transverse plane of the engine parts to prevent leakage. Patent 1635963. C. H. Seifert, 165 Front St., Hempstead, L. I., N. Y.

Railways and their Accessories

LATERAL-MOTION BEARING FOR JOURNAL BOXES—A renewable railway journal box for supporting a lateral motion bearing of relatively soft material, so that the wheel may turn without appreciable friction. Patent 1635124. A. F. Hoegg, 217 Kline St., Weatherly, Pa.

OPERATING MECHANISM FOR DIRIGIBLE HEADLIGHTS—Which will automatically tilt the headlight of a locomotive to follow the roadway when rounding a curve, but will maintain the normal position on straight lines. Patent 1635097. T. P. Salley, 188 Clarkson Ave., Brooklyn, N. Y.

Pertaining to Recreation

BASEBALL GLOVE—A fielder's glove, having flexible and automatically adjustable connection between the back portion of certain fingers, and the thumb and adjacent finger. Patent 1631735. P. and B. Kennedy, c/o Ken-Wel Sporting Goods Co., Gloversville, N. Y.

MOVABLE FEATURE FIGURE TOY—Of the jack-o'-lantern type which has novel movable parts, the device can be held and operated by one hand. Patent 1632272. J. L. Centlivere, 311½ Second St., Laramie, Wyoming.

TOY—Including a driving motor for actuating a wheel on which toy cars are suspended, and means for controlling the operation at a substantially uniform speed. Patent 1633496. C. E. Richardson, Simpsonville, S. C.

EXERCISING APPARATUS—Comprising elastic members superposed in strip form so that

they can be varied at will, and retained by a pair of hand grip members. Patent 1633124. R. H. Noe, 739 No. Auburndale, Memphis, Tenn.

CLOCK-DIAL GAME—Simulating the face of a clock with movable hands, and numbers from 1 to 12, the spaces including "nursery rhymes," for children learning the method of telling time. Patent 1634197. G. Kent, c/o John McKey, Newton Center, Mass.

PLAY-BALL COVERING—More particularly for inflated balls, composed of particolor zones, and forming a perfect sphere of supplemental gores of suitable material, such as rubberized fabric. Patent 1634146. B. L. Henry, Imperial Hotel, Broadway and 31st St., New York, N. Y.

Pertaining to Vehicles

CLOSURE-CAP LOCK—Particularly useful in connection with tank trucks carrying inflammable material, means being provided for attaching a grounding lead to discharge static electricity from the tank. Patent 1633218. F. A. McDonald and F. G. Welke, 1538 Eleventh Ave., San Francisco, Calif.

ATTACHMENT OF MOTOR-VEHICLE ROAD SPRINGS—Appreciable to springs which are hingedly attached either direct to the vehicle frame or to the axle, or a bracket, as well as by means of a shackle. Patent 1634158. D. Robertson, c/o Collision & Co., 483 Collins St., Melbourne, Australia.

CUSHIONING MEANS FOR TILTABLE AUTOMOBILE SEATS—Adapted to support the rear end of "jump" seats of the coach type of automobile, the cushion may be easily removed or replaced. Patent 1633697. C. C. Davis and G. I. Clark, Box B. 4, c/o Edmarr, West Palm Beach, Fla.

FLEXIBLE SPOTTER FOR REPAIRING TIRE CASINGS—Which accommodates itself to the various contours presented in the work, and will bring about uniform even contact with the place to be repaired. Patent 1632651. E. A. Hubbard, 206 East Railroad Ave., Flagstaff, Arizona.

ATTACHMENT FOR TRACTORS—Which permits the operator to steer with one foot, thus he is relieved of hand driving and permitted undivided attention to operating the plow. Patent 1632311. L. S. Phelps, R. F. D. No. 4, Box 13, Watseka, Ill.

DISPLAY DEVICE—For projecting the license number upon the rear of a vehicle at night, using the vehicle body as a screen, conveniently attached to various types of cars. Patent 1632607. A. H. Kogge, 565 South Main St., Hightstown, N. J.

LOCK FOR AUTOMOBILES—For opening and closing the ignition circuit, readily operated by an authorized person, while an unauthorized person would lock the same against functioning. Patent 1632576. R. Alfisi, 2243-33rd St., Brooklyn, N. Y.

LUBRICATING DEVICE FOR VEHICLE SPRINGS—Which includes a reservoir and oil distributing units insertable between the leaves of a spring, and a conduit for automatically conducting oil. Patent 1630581. W. K. Riley, 525 Mortimer Ave., Huntington Park, Calif.

HYDRAULIC BRAKE—Permitting a braking action to be obtained regardless of the direction of rotation of the rotor, and for permanently locking the rotor against rotation. Patent 1631800. F. Dotsch, Westmoreland Ave. & Intervale St., White Plains, N. Y.

POWER-TRANSMISSION MECHANISM FOR MOTOR VEHICLES—Constructed so that two axels may be driven simultaneously in one direction or in opposite directions, or one section driven while the other remains stationary. Patent 1631837. G. M. Stone, Route 1, Griswold, Iowa.

TIRE BUILDING CORE—Having a shaping surface substantially triangular in cross section, which may be removed from the tire with very little distorting effect. Patent 1631855. B. DeMattia, c/o Munn, Anderson & Munn, 24 W. 40th St., New York, N. Y.

COMBINED LICENSE-PLATE AND IDENTIFICATION-CARD HOLDER—Including the name of the owner, the make of car, etc., and will also serve to prevent the switching of the plate from one vehicle to another. Patent 1633414. A. G. Lorenz, 2403 Battery St., Little Rock, Ark.

DIRIGIBLE HEADLIGHT—More particularly relating to an auxiliary headlamp or spot light for use in conjunction with the main stationary headlights, but swinging with the steering wheels. Patent 1633442. S. P. Foster, c/o John S. Wrinkle, Volunteer State Like Bldg., Chattanooga, Tenn.

BRAKING OF MOTOR AND OTHER VEHICLES—Which gives braking action its maximum intensity at high speed, prevents wedging of the wheels, and varies the action according to the type of wheel. Patent 1634186. P. Hallot, c/o Office Picard 97 Rue St. Lazare, Paris, France.

DETECTOMETER—Employing a dial and a movable hand for accurately indicating the temperature of the water within the radiator of an automobile. Patent 1633930. H. H. Dudley, 816 Southern R. R. Bldg., Cincinnati, Ohio.

Designs

DESIGN FOR A COMBINED ASH RECEIVER AND MATCH BOX—Patent 72803. A. W. Rosen, 610 Broadway, New York, N. Y.

DESIGN FOR A DRESS—Patent 72792. T. Davis, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A SHOE—The inventor has been granted three patents for ornamental designs for shoes. Patents 72789, 72790, and 72791. T. Davis, c/o Franklin Simon Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A DRESS—Patent 73013. Maude Siegel, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A CONTAINER FOR TABLE SERVICE—Patent 72936. P. L. Ebarle, 571A Natoma St., San Francisco, Calif.

DESIGN FOR AN ELECTRIC LAMP—Patent 72997. M. Gordon, 6019 Winthrop Ave., Chicago, Ill.

DESIGN FOR A DRESS—Patent 73011. M. Rochas, c/o David Crystal Inc., 1351 Broadway, New York, N. Y.

DESIGN FOR A DRESS—Patent 73001. R. Lemoine, c/o David Crystal Inc., 1351 Broadway, New York, N. Y.

DESIGN FOR A DRESS—Patent 73071. T. Davis, c/o Franklin Simon & Co., 5th Ave & 38th St., New York, N. Y.

DESIGN FOR GOBLET OR SIMILAR ARTICLE—Patent 72968. E. C. Schrader, c/o Economy Glass Co., Morgantown, W. Va.

DESIGN FOR A VANITY CASE—Patent 72941. M. C. de Botelho, c/o Products Bertie, 120 W. 42nd St., New York, N. Y.

DESIGN FOR A LAMP—Patent 72950. J. T. Jaret, c/o Sun-Ray Lighting Products Co., 119 Lafayette St., New York, N. Y.

DESIGN FOR A GLOVE—Patent 72915. I. E. Steinberger, c/o Steinberger Bros., 230-5th Ave., New York, N. Y.

DESIGN FOR A SMOKER'S STAND OR THE LIKE—Patent 72902. C. P. Knapp, 116 W. 39th St., New York, N. Y.

DESIGN FOR A PEDESTAL OR THE LIKE—Patent 72910. E. T. Palmenberg, c/o J. R. Palmenberg's Sons, 63 W. 36th St., New York, N. Y.

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INDEX TO ADVERTISERS

SCIENTIFIC AMERICAN—OCTOBER, 1927

American Lead Pencil Co.....	366	Metallic Sign Letter Co.....	369
American Pipe Bending Machine Co.....	368	Metro Electric Company.....	290-357
American Sheet & Tin Plate Co.....	365	William Moge & Sons, Inc.....	360
American Telephone & Telegraph Co.....	360	Moore & Company.....	373
Aviation Institute of U. S.....	370	Munn & Company.....	377-383
Francis Bannerman Sons.....	364	National Carbon Company.....	359
Bernard & Heller.....	369	Nicholson File Company.....	366
Black and Blue Print Co.....	366	Norton Company.....	351
Box 176.....	360	Packard Motor Car Company.....	Third Cover
Brief English Systems, Inc.....	368	Pathfinder Publishing Co.....	368
Broderick & Bascom Rope Co.....	361	Pierce-Arrow Motor Car Company.....	353
Chicago Stock Gear Works.....	373	Portland Manufacturing Company.....	362
Cortez Cigar Co.....	364	R. J. Reynolds Tobacco Company.....	Fourth Cover
Dayton Steel Foundry Company.....	369	Royal Typewriter Company, Inc.....	Second Cover
Demco, Inc.....	373	William A. Schaerr.....	364
F. J. Drake & Co.....	369	Schwerdtle Stamp Co.....	373
Du Maurier Company.....	371	Scientific Apparatus Corp.....	360
Encyclopaedia Britannica, Inc.....	291	Shields Engineering & Pub. Co.....	371
Ethyl Gasoline Corporation.....	349	Simonds Saw & Steel Company.....	368
Experimenter Supply House.....	370	S K F Industries, Inc.....	289
Federal Schools, Inc.....	374	Stephenson Laboratory.....	373
Firestone Tire & Rubber Company.....	364	Taylor Instrument Companies.....	375
Florsheim Shoe Company.....	377	Technical Products Company.....	360
Forhan Company.....	370	Timken Roller Bearing Company.....	292
General Electric Company.....	384	Treasure Sales Company.....	364
Gutttag Bros.....	370	Unisol Manufacturing Company.....	364
Hobart Bros.....	368-373	U. S. Tobacco Company.....	367
International Harvester Company.....	347	United Electric Motor Co.....	373
International Typewriter Exchange.....	370	Veeder Manufacturing Company.....	373
Laboratory Materials Company.....	360	Vilter Manufacturing Company.....	364
Lambert Pharmacal Company.....	355	J. D. Wallace & Company.....	368
Liggett & Myers Tobacco Company.....	371	Woodstock Typewriter Company.....	366
Los Angeles Chamber of Commerce.....	294	Wisconsin Electric Company.....	372
G. & C. Merriam Company.....	383	Wisconsin Motor Mfg. Co.....	363
Metal Cast Products Company.....	360	Henry Zuhr.....	383

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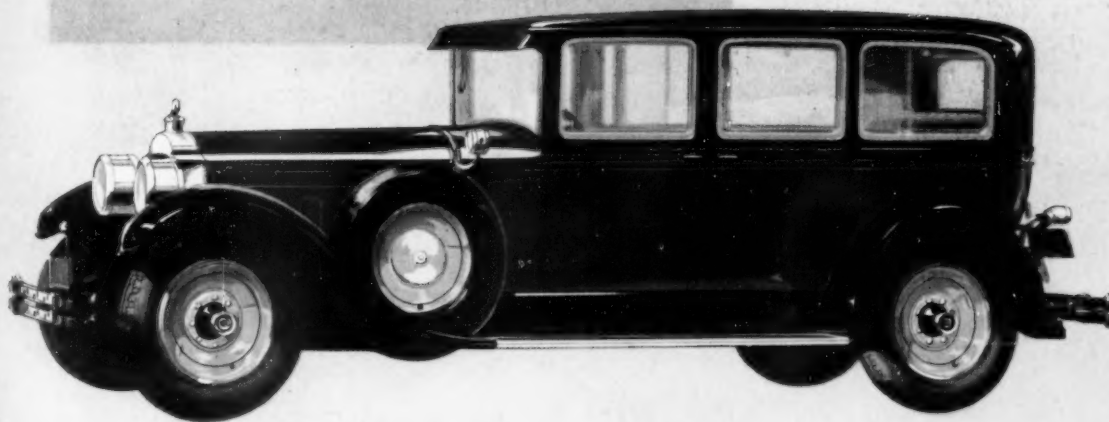
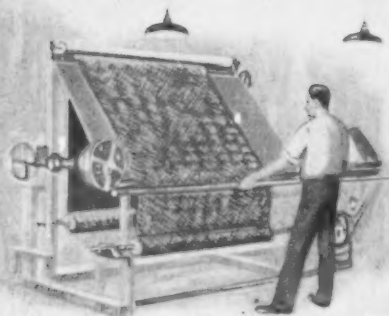


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